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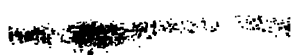








THE UNIVERSITY OF CHICAGO PRESS



*Ch. Liveside.*

AN ACCOUNT  
OF SOME  
GEOLOGICAL SPECIMENS  
FROM THE  
COASTS OF AUSTRALIA.

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BY WILLIAM HENRY FITTON,  
M.D., F.R.S., V.P.G.S., &c.

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From the Appendix to the "Narrative of a Survey of the Inter-tropical  
and Western Coasts of Australia," &c., by Captain Phillip.  
Parker King, R.N., vol. ii. p. 566, &c.

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LONDON:  
PRINTED BY W. CLOWES, NORTHUMBERLAND-COURT.

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*An Account of some Geological Specimens, collected by Captain P. P. King, in his Survey of the Coasts of Australia, and by Robert Brown, Esq., on the Shores of the Gulf of Carpentaria, during the Voyage of Captain Flinders.*

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By WILLIAM HENRY FITTON, M.D., F.R.S., V.P.G.S.

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[Read before the Geological Society of London, 4th November, 1825.]

THE following enumeration of specimens from the coasts of Australia, commences, with the survey of Captain King, on the eastern shore, about the latitude of twenty-two degrees, proceeding northward and westward: and as the shores of the Gulf of Carpentaria, previously surveyed by Captain Flinders, were passed over by Captain King, Mr. Brown, who accompanied the former, has been so good as to allow the specimens collected by himself in that part of New Holland, to supply the chasm which would otherwise have existed in the series. Part of the west and north-western coast, examined by Captain King, having been previously visited by the French voyagers, under Captain Baudin, I was desirous of obtaining such information as could be derived from the specimens collected during that expedition, and now remaining at Paris; although I was aware that the premature death of the principal mineralogist, and other unfavourable circumstances, had probably diminished their value\*:—But the collection from New Holland, at the

\* M. Depuch, the mineralogist, died during the progress of the voyage, in 1803; and, unfortunately, none of his manuscripts

school of Mines, with a list of which I have been favoured through the kindness of Mr. Brochant de Villiers, relates principally to Van Diemen's Land; and that of the Jardin du Roi, which Mr. Constant Prevost has obliged me with an account of, does not afford the information I had hoped for. I have availed myself of the notices relating to Physical Geography and Geology, which are dispersed through the published accounts of Captain Flinders'\*, and Baudin's Voyages†; and these, with the collections above alluded to, form, I believe, the only sources of information at present existing in Europe, respecting the geological structure and productions of the north and western coasts of Australia.

In order to avoid the interruption which would be occasioned by detail, I shall prefix to the list of specimens in Captain King's and Mr. Brown's collections, a general sketch of the coast from whence they come, deduced, principally, from the large charts‡, and from the narratives of

were preserved. M. Péron, the zoologist, after publishing, in 1807, the first volume of the account of the expedition, died in 1810, before the appearance of the second volume.—Voyage, &c. I, p. 417, 418; and II, p. 163.

\* 'A Voyage to Terra Australia, &c., in the years 1801, 1802, and 1803, by Matthew Flinders, Commander of the Investigator.' Two vols. quarto, with an atlas, folio; London, 1814.

† 'Voyage de Découverte aux Terres Australes,' &c.—Tome I., redigé par M. F. Péron, naturaliste de l'Expedition;—Paris, 1807. Tome II., redigé par M. Péron, et M. L. Freycinet; 1816.—A third volume of this work, under the title of "Navigation et Géographie," was published by Capt. Freycinet, in 1815. It contains a brief and clear account of the proceedings of the expedition; and affords some particulars connected with the physical geography of the places described, which are not to be found in the other volumes.

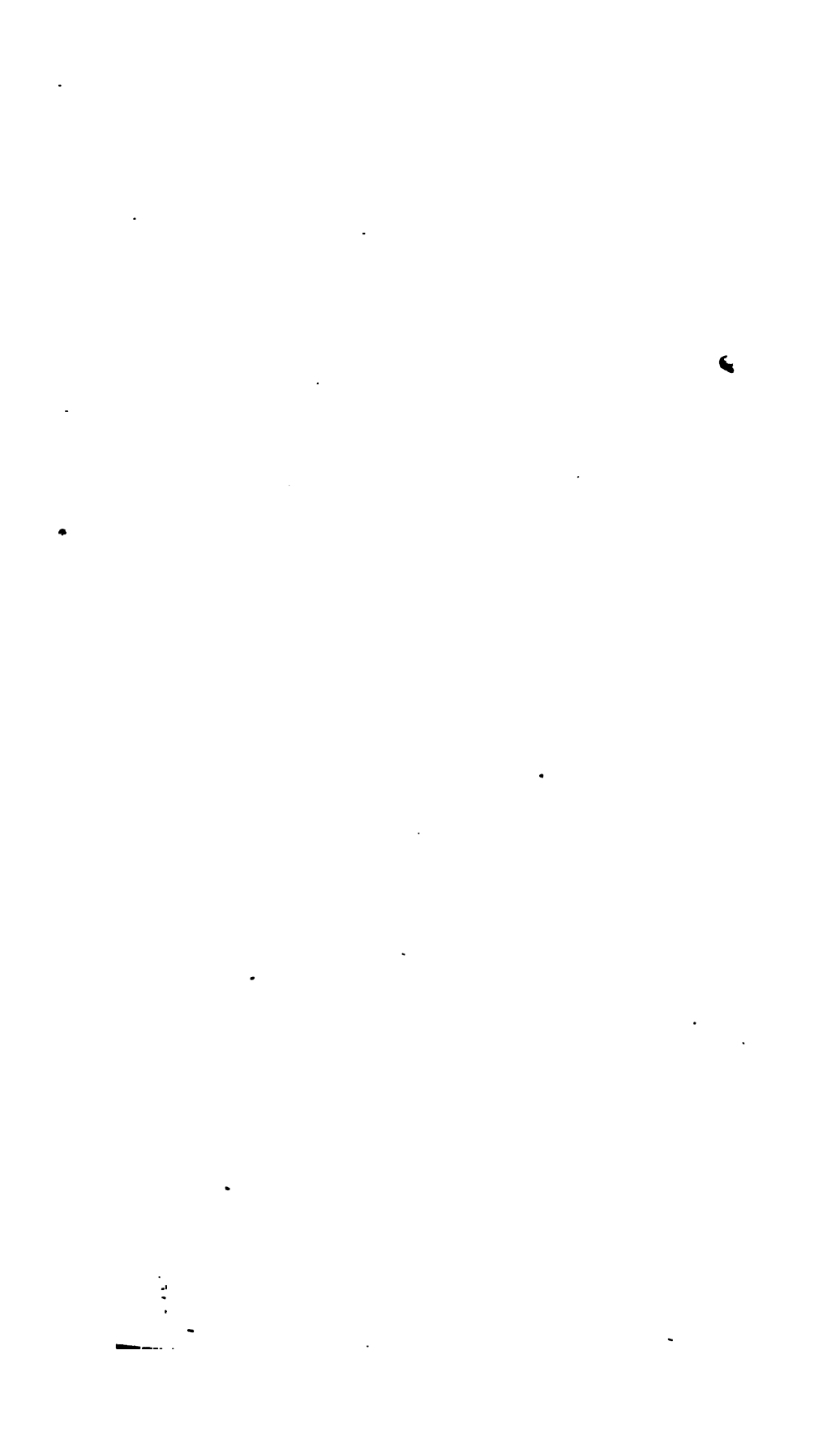
‡ These charts have been published by the Admiralty, for general sale.

Captains Flinders and King,—with a summary of the geological information derived from the specimens. But I have thought it necessary to subjoin a more detailed list of the specimens themselves; on account of the great distance from each other of many of the places where they were found, and of the general interest attached to the productions of a country so very remote, of which the greater part is not likely to be often visited by geologists. The situation of such of the places mentioned, as are not to be found in the reduced chart prefixed to the present publication, will be sufficiently indicated by the names of the adjacent places.

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*GENERAL SKETCH OF THE COAST.*

THE north-eastern coast of New South Wales, from the latitude of about  $28^{\circ}$ , has a direction from south-east to north-west; and ranges of mountains are visible from the sea, with little interruption, as far north as Cape Weymouth, between the latitude of  $12^{\circ}$  and  $13^{\circ}$ . From within Cape Palmerston, west of the Northumberland Islands, near the point where Captain King began his surveys, a high and rocky range, of very irregular outline, and apparently composed of primitive rocks, is continued for more than one hundred and fifty miles, without any break; and after a remarkable opening, about the latitude of  $21^{\circ}$ , is again resumed. Several of the summits, visible from the sea, in the front of this range, are of considerable elevation:—Mount Dryander, on the promontory which terminates in Cape Gloucester, being more than four thousand five hundred feet high. Mount Eliot, with a peaked summit, a little to the south of Cape Cleveland, is visible at twenty-five leagues' distance; and Mount Hinchinbrook, immediately upon the shore, south of Rockingham Bay, is more than two thousand feet high. From the south



Along this eastern line of shore, granite has been found, throughout a space of nearly five hundred miles;—at Cape Cleveland;—Cape Grafton;—Endeavour River;—Lizard Island;—and at Clack's Island, on the north-west of the rocky mass which forms Cape Melville. And rocks of the trap formation have been obtained in three detached points among the islands off the shore;—in the Percy Isles, about latitude  $21^{\circ} 40'$ ;—Sunday Island, north of Cape Grenville, about latitude  $12^{\circ}$ ; and Good's Island, on the north-west of Cape York, latitude  $10^{\circ} 34'$ .

The Gulf of Carpentaria having been fully examined by Captain Flinders, was not visited by Captain King; but the following account has been deduced from the voyage and charts of the former, combined with the specimens collected by Mr. Brown, who has also favoured me with an extract from the notes taken by himself on that part of the coast.

The land, on the east and south of the Gulf of Carpentaria, is so low, that for a space of nearly six hundred miles,—from Endeavour Strait to a range of hills on the mainland, west of Wellesley Islands, at the bottom of the gulf,—no part of the coast is higher than a ship's mast-head\*. Some of the land in Wellesley islands is higher than the main; but the largest island is, probably, not more than one hundred and fifty feet in height†; and low-wooded hills occur on the mainland, from thence to Sir Edward Pellew's group. —The rock observed on the shore at Coen River, the only point on the eastern side of the Gulf where Captain Flinders landed, was calcareous sandstone of recent concretionary formation.

In Sweer's Island, one of Wellesley's Isles, a hill of

\* Flinders' Charts, Plate XIV.

† Flinders, Vol. II., p. 158.



about fifty or sixty feet in height was covered with a sandy calcareous stone, having the appearance of 'concretions rising irregularly about a foot above the general surface, without any distinct ramifications.' The specimens from this place have evidently the structure of stalactites, which seem to have been formed in sand; and the reddish carbonate of lime, by which the sand has been agglutinated, is of the same character with that of the west coast, where a similar concreted limestone occurs in great abundance.

The western shore of the Gulf of Carpentaria is somewhat higher, and from Limmen's Bight to the latitude of Groote Eylandt, is lined by a range of low hills. On the north of the latter place, the coast becomes irregular and broken; the base of the country apparently consisting of primitive rocks, and the upper part of the hills of a reddish sandstone;—some of the specimens of which are identical with that which occurs at Goulburn and Sims Islands on the north coast, and is very widely distributed on the north-west. The shore at the bottom of Melville Bay is stated by Captain Flinders to consist of low cliffs of pipe-clay, for a space of about eight miles in extent from east to west; and similar cliffs of pipe-clay are described as occurring at Goulburn Islands, (see the annexed plate,) and at Lethbridge Bay, on the north of Melville Island: both of which places are considerably to the west of the Gulf of Carpentaria.

Morgan's Island, a small islet in Blue-Mud Bay, on the north-west of Groote Eylandt, is composed of clink-stone; and other rocks of the trap-formation occur in several places on this coast.

The north of Blue-Mud Bay has furnished also specimens of ancient sandstone; with columnar rocks, probably of clink-stone. Round Hill, near Point Grindall, a promontory



From a Sketch by J. J. Ross

VIEW OF SOUTH WEST BAY GOULBURN ISLAND.  
WATERING PARTY ATTACKED BY NATIVES.



on the north of Morgan's Island, is composed, at the base, of granite; and Mount Caledon, on the west side of Caledon Bay, seems likewise to consist of that rock, as does also Melville Island. This part of the coast has afforded the ferruginous oxide of manganese: and brown hematite is found hereabouts in considerable quantity, on the shore at the base of the cliffs; forming the cement of a breccia, that contains fragments of sand-stone, and in which the ferruginous matter appears to be of very recent production;—resembling, perhaps, the hematite observed at Edinburgh by Professor Jameson, around cast-iron pipes which had lain for some time in sand\*.

The general range of the coast, it will be observed, from Limmen's Bight to Cape Arnhem, is from south-west to north-east; and three conspicuous ranges of islands on the north-western entrance of the Gulf of Carpentaria, the appearance of which is so remarkable as to have attracted the attention of Captain Flinders†, have the same general direction: a fact which is probably not unconnected with the geological structure of the country. The prevailing rock in all these islands appears to be sand-stone.

The line of the main coast from Point Dale to the bottom of Castlereagh Bay, where Captain King's survey was resumed, has also a direction from south-west to north-east, parallel to that of the ranges of islands just mentioned. The low land near the north coast in Castlereagh Bay, and from thence to Goulburn Islands, is intersected by one of the few rivers yet discovered in this part of Australia,—a tortuous and shallow stream, named Liverpool River, which has been traced inland to about forty miles from the coast, through a country not more than three feet in general

\* Edinb. Phil. Jour., July, 1825, p. 193.

† Flinders, Vol. II., p. 158.—See hereafter, p. 33, &c.

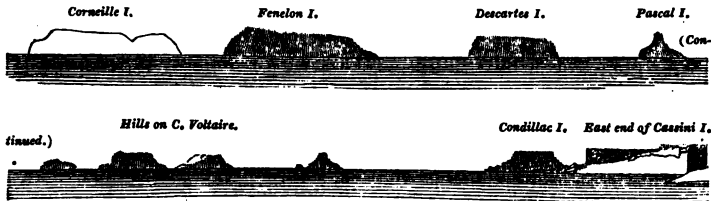
elevation above high-water mark ; the banks being low and muddy, and thickly wooded :—And this description is applicable also to the Alligator Rivers on the south-east of Van Diemen's Gulf, and to the surrounding country. The outline of the Wellington Hills, however, on the mainland between the Liverpool and Alligator Rivers, is jagged and irregular ; this range being thus remarkably contrasted with the flat summits which appear to be very numerous on the north-western coast.

The specimens from Goulburn Islands consist of reddish sand-stone, not to be distinguished from that which occurs beneath the coal formation in England. On the west of these islands the coast is more broken, and the outline is irregular : but the elevation is inconsiderable ; the general height in Cobourg Peninsula not being above one hundred and fifty feet above the sea, and that of the hills not more than from three to four hundred feet.

On this part of the coast, several hills are remarkable for the flatness of their tops ; and the general outline of many of the islands, as seen on the horizon, is very striking and peculiar. Thus Mount Bedwell and Mount Roe, on the south of Cobourg Peninsula ; Luxmoore Head, at the west end of Melville Island ; the Barthelemy Hills, south of Cape Ford ; Mount Goodwin, south of Port Keats ; Mount Cockburn, and several other hills adjacent to Cambridge Gulf,—the names given to which during the progress of the survey sufficiently indicate their form, as *House-roofed*, *Bastion*, *Flat-top*, and *Square-top Hills* ;—Mount Casuarina, about forty miles north-west of Cambridge Gulf ; a hill near Cape Voltaire ;—Steep-Head, Port Warrender ;—and many of the islands off that port, York Sound, and Prince Regent's River ;—Cape Cuvier, about latitude  $24^{\circ}$  ;—and, still further south, the whole of Moresby's flat-topped Range,—are all distinguished

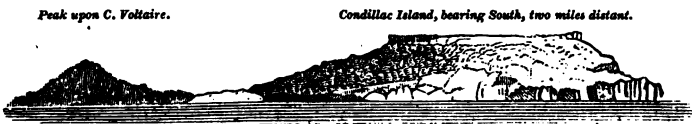
by their linear and nearly horizontal outlines; and except in a few instances, as Mount Cockburn, Steep-Head, Mounts Trafalgar and Waterloo, (which look more like hills of float-trap,) they have very much the aspect of the summits in the coal formation\*.

The subjoined sketch of some of the islands off Admiralty Gulf, (looking southward from the north-east end of Cassini Island, about lat.  $13^{\circ} 50'$ , E. long.  $125^{\circ} 50'$ .) has some resemblance to one of the views in Péron's Atlas (pl. vi., fig. 7):—



and the outline of the Iles Forbin (pl. viii., fig. 5, of the same series),

also exhibits remarkably the peculiar form represented in several of Captain King's drawings.



The red colour of the cliffs on the north-west and west coasts, is also an appearance which is frequently noticed in

\* Captain King, however, has informed me, that in some of these cases, the shape of the hill is really that of a roof, or haystack; the tranverse section being angular, and the horizontal top an edge.

the sketches taken by Captain King and his officers. This is conspicuous in the neighbourhood of Cape Croker;—at Darch Island, and Palm Bay; at Point Annesley, and Point Coombe, in Mountnorris Bay;—in the land about Cape Van Diemen, and on the north-west of Bathurst Island. The cliffs on Roe's River (Prince Frederic's Harbour), as might have been expected from the specimens, are described as of a reddish colour; Cape Lévêque is of the same hue; and the northern limit of Shark's Bay, Cape Cuvier of the French, lat.  $24^{\circ} 13'$ , which is like an enormous bastion, may be distinguished at a considerable distance by its full red colour \*.

It is on the bank of the channel which separates Bathurst and Melville Islands, near the north-western extremity of New Holland, that a new colony has recently been established: (see Captain King's Narrative, vol. ii., p. 233.) A permanent station under the superintendence of a British officer, in a country so very little known, and in a situation so remote from any other English settlement, affords an opportunity of collecting objects of natural history, and of illustrating various points of great interest to physical geography and meteorology, which it is to be hoped will not be neglected. And as a very instructive collection, for the general purposes of geology, can readily be obtained in such situations, by attending to a few precautions, I have thought that some brief directions on this subject would not be out of place in the present publication; and have subjoined them to the list of specimens at the close of this paper †.

In the vicinity of Cambridge Gulf, Captain King states, the character of the country is entirely changed;—and irre-

\* Freycinet, p. 195.

† See hereafter, page 58.







From a sketch by J. H. R. H. C.

VIEW OF MOUNT COCHETUAT AT NEW BEDFORD, MASS.  
TAKEN FROM THE WATER

gular ranges of detached rocky hills composed of sand-stone, rising abruptly from extensive plains of low level land, supersede the low and woody coast, that occupies almost uninterruptedly the space between this inlet and Cape Wessell, a distance of more than six hundred miles. Cambridge Gulf, which is nothing more than a swampy arm of the sea, extends to about eighty miles inland, in a southern direction: and all the specimens from its vicinity precisely resemble the older sand-stones of the confines of England and Wales \*. The View, (in the annexed plate,) represents in the distance Mount Cockburn, at the head of Cambridge Gulf; the flat rocky top of which was supposed to consist of sand-stone, but has also the aspect of the trap-formation. The strata in Lacrosse Island, at the entrance of the Gulf, rise toward the north-west,—at an angle of about  $30^{\circ}$  with the horizon: their direction consequently being from north-east to south-west.

From hence to Cape Londonderry, towards the south, is an uniform coast of moderate elevation; and from that point to Cape Lévêque, although the outline may be in a general view considered as ranging from north-east to south-west †, the coast is remarkably indented, and the adjoining sea irregularly studded with very numerous islands. The specimens from this tract consist almost entirely of sand-stone, resembling that of Cambridge Gulf, Goulburn Island, and

\* I use the term 'Old Red Sand Stone,' in the acceptation of Messrs. Buckland and Conybeare, "Observations on the South Western Coal District of England." Geol. Trans., Second Series, Vol. I.—Captain King's specimens from Lacrosse Island are not to be distinguished from the slaty strata of that formation, in the banks of the Avon, about two miles below Clifton.

† The large chart (Sheet V.) best shews the general range of the shore, from the islands filling up the inlets.

the Gulf of Carpentaria; with which the trap-formation appears to be associated.

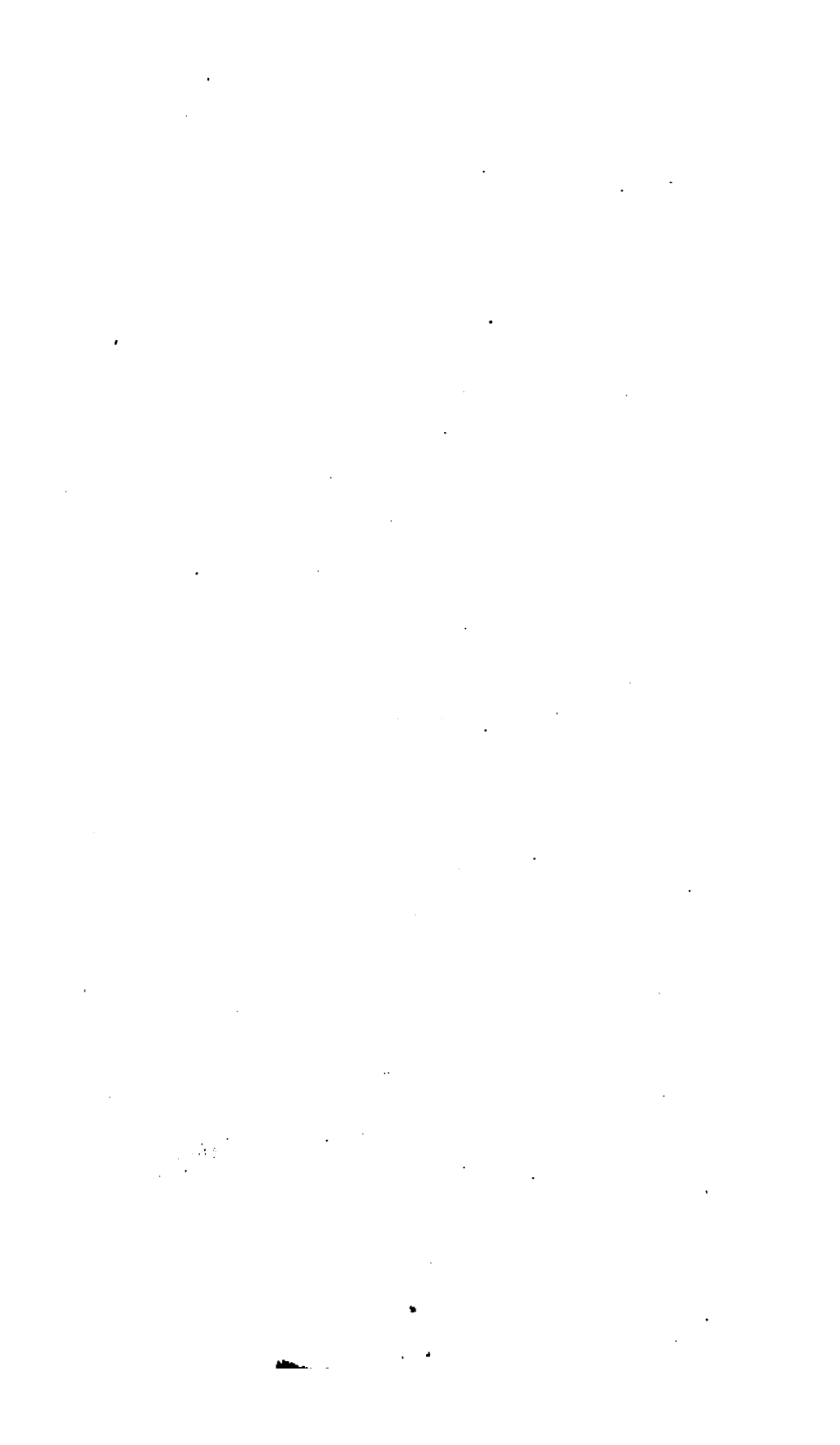
York Sound, one of the principal inlets on this part of the coast, is bounded by precipitous rocks, from one to two hundred feet in height; and some conical rocky peaks, which not improbably consist of quartz-rock, were noticed on the eastern side of the entrance. An unpublished sketch, by Captain King, shews that the banks of Hunter's River, one of the branches of York Sound, at seven or eight miles from its opening, are composed of sand-stone, in beds of great regularity; and this place is also remarkable for a copious spring of freshwater, one of the rarest phenomena of these thirsty and inhospitable shores\*.

The most considerable inlet, however, which has yet been discovered in this quarter of Australia, is Prince-Regent's River, about thirty miles to the south-west of York Sound,—the course of which is almost rectilinear for about fifty miles in a south-eastern direction; a fact which will probably be found to be connected with the geological structure of the country. The general character of the banks, which are lofty and abrupt, is precisely the same with that of the rivers falling into York Sound; and the level of the country does not appear to be higher in the interior than near the coast. The banks are from two to four hundred feet in height, and consist of close-grained siliceous sand-stone, of a reddish hue†; and the view, (See the annexed plate,) shews that the beds are nearly horizontal, and very regularly disposed; the cascade there represented being about one hundred and sixty feet in height, and the beds from six to twelve feet in thickness. Two conspicuous hills, which Captain King

\* Narrative, i. p. 405.

† Narrative i. pp. 434-437, and II. p. 45.







has named Mounts Trafalgar and Waterloo, on the north-east of Prince-Regent's River, not far from its entrance, are remarkable for cap-like summits, much resembling those which characterize the trap formation.

*Mount Trafalgar. Mount Waterloo.*



The coast on the south of this remarkable river, to Cape Lévêque, has not yet been thoroughly examined; but it appears from Captain King's Chart (No. V.) to be intersected by several inlets of considerable size, to trace which to their termination is still a point of great interest in the physical geography of New Holland. The space thus left to be explored, from the Champagne Isles to Cape Lévêque, corresponds to more than one hundred miles in a direct line; within which extent nothing but islands and detached portions of land have yet been observed. One large inlet especially, on the south-east of Cape Lévêque, appears to afford considerable promise of a river; and the rise of the tide within the Buccaneer's Archipelago, where there is another unexplored opening, is no less than thirty-seven feet.

The outline of the coast about Cape Lévêque itself is low, waving, and rounded; and the hue for which the cliffs are remarkable in so many parts of the coast to the north, is also observable here, the colour of the rocks at Point Coulomb being a deep red:—but on the south of the high ground

near that Point, the rugged stony cliffs are succeeded by a long tract, which to the French voyagers (for it was not examined by Captain King,) appeared to consist of low and sandy land, fronted by extensive shoals. It has hitherto been seen, however, only at a distance; so that a space of more than three hundred miles, from Point Gantheaume nearly to Cape Lambert, still remains to be accurately surveyed.

Depuch Island, east of Dampier's Archipelago, about latitude  $20^{\circ} 30'$ , is described by the French naturalists as consisting in a great measure of columnar rocks, which they supposed to be *volcanic*; and they found reason to believe that the adjoining continent was of the same materials \*. It is not improbable, however, that this term was applied to columns belonging to the trap formation, since no burning mountain has been any where observed on the coast of New Holland:—nor do the drawings of Depuch Island, made on board Captain King's vessel, give reason to suppose that it is at present eruptive. Captain King's specimens from Malus Island, in Dampier's Archipelago, (sixty miles farther west) consist of green-stone and amygdaloid.

The coast is again broken and rugged about Dampier's Archipelago, latitude  $20^{\circ} 30'$ ; and on the south of Cape Preston, in latitude  $21^{\circ}$ , is an opening of about fifteen miles in width, between rocky hills, which has not been explored. From thence to the bottom of Exmouth Gulf,—more than one hundred and fifty miles, the coast is low and sandy, and does not exhibit any prominences. The west coast of Exmouth Gulf itself is formed by a promontory of level land, terminating in the North-west Cape; and from thence to the south-west, as far as Cape Cuvier, the general height of the

\* Péron, vol. i. p. 130.

coast is from four to five hundred feet; nor are any mountains visible over the coast range.

Several portions of the shore between Shark's Bay and Cape Naturaliste have been described in the account of Commodore Baudin's Expedition; but some parts still remain to be surveyed. From the specimens collected by Captain King, and the French descriptions, it appears that the islands on the west of Shark's Bay abound in a concretionary calcareous rock of very recent formation, similar to what is found on the shore in several other parts of New Holland, especially in the neighbourhood of King George's Sound;—and which is abundant also on the coast of the West Indian Islands, and of the Mediterranean. Captain King's specimens of this production are from Dirk Hartog's and Rottnest Islands; and M. Péron states that the upper parts of Bernier and Dorre Islands are composed of a rock of the same nature. This part of the coast is covered in various places with extensive dunes of sand; but the nature of the base, on which both these and the calcareous formation repose, has not been ascertained.

The general direction of the rocky shore, from North-west Cape to Dirk Hartog's Island, is from the east of north to the west of south. On the south of the latter place the land turns towards the east. High, rocky and reddish cliffs have been seen indistinctly about latitude  $27^{\circ}$ ; and a coast of the same aspect has been surveyed, from Red Point, about latitude  $28^{\circ}$ , for more than eighty miles to the south-west. The hills called Moresby's flat-topped Range, of which Mount Fairfax, latitude  $28^{\circ} 45'$ , is the highest point, occupy a space of more than fifty miles from north to south.

Rottnest Island and its vicinity, latitude  $32^{\circ}$ , contains in abundance the calcareous concretions already mentioned;



which there seem to consist in a great measure of the remains of recent shells, of several species. The islands of this part of the shore have been described by MM. Péron and Freycinet \*; and the coast to the south, down to Cape Leeuwin, the south-western extremity of New Holland, having been sufficiently examined by the French voyagers, was not surveyed by Captain King.

Swan River, (*Rivière des Cygnes*,) upon this part of the coast, latitude  $31^{\circ} 25'$  to  $32^{\circ}$ , was examined by the French expedition, to the distance of about twenty leagues from its mouth; and found still to contain salt water. The rock in its neighbourhood consisted altogether of sandy and calcareous incrustations, in horizontal beds, enclosing, it is stated, shells, and the roots and even trunks of trees. Between this river and Cape Péron, a "great bay" was left unexplored †.

The prominent mass of land, which stands out from the main, between Cape Naturaliste and Cape Leeuwin, and runs nearly on the meridian for more than fifty miles, seems to have a base of granite, which, at Cape Naturaliste, is said to be stratified ‡. The same rock also occurs, among Captain King's specimens, from Bald-head in King George's Sound; but nearly on the summit of that hill, which is about five hundred feet high, were found the ramified calcareous concretions, erroneously considered as corals by Vancouver and others §; but which appear, from Captain King's specimens,

\* Péron, vol. ii. p. 168, &c.

† Péron, vol. i. p. 179. Freycinet, p. 5. 170.

‡ Péron, vol. i. p. 69.

§ Vancouver, i. 49. D'Entrecasteaux, ii. 175. Freycinet, 105. Flinders, i. 63.—See the detailed descriptions, hereafter, p. 56-7; and Captain King's Narrative, vol. i. p. 12.

to be nothing more than a variety of the recent limestone so abundant throughout these shores.

The south coast, and the southern portion of the east coast of Australia, which were surveyed by Captain Flinders, are described in the account of his voyage, and do not come within the object of the present paper.

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#### GEOLOGICAL REMARKS.

I. THE rocks, of which specimens occur in the collections of Captain King and Mr. Brown, are the following:—

<i>Granite</i>	. . . . .	Cape Cleveland; C. Grafton; Endeavour River; Lizard I.; Round Hill, near C. Grindall; Mount Caledon; Island near C. Arnhem; Melville Bay; Bald-head, King George's Sound.
<i>Various Slaty Rocks,</i>		
<i>Mica-Slate</i>	. . . . .	Mallison's I.
<i>Talc-Slate</i>	. . . . .	Endeavour River.
<i>Slaty Clay</i>	. . . . .	Inglis's I., Clack I., Percy I.
<i>Hornblende Rock?</i>	. . . . .	Pobasoo's Island; Half-way Bay, P. Regent's River.
<i>Granular Quartz</i>	. . . . .	Endeavour River; Montagu-Sound, North-west Coast.
<i>Epidote</i>	. . . . .	C. Clinton?; Port Warrender; Carrening Bay.
<i>Quartzose Conglomerates, and ancient Sandstones</i>	. . . . .	Rodd's Bay; Islands of the north and north-west coasts; Cambridge Gulf; York Sound; P. Regent's River.
<i>Pipe-clay</i>	. . . . .	Melville Bay; Goulburn I.; Lethbridge Bay.

*Rocks of the Trap Formation.*

<i>Serpentine</i>	. . . . .	Port Macquarie; Percy Isles.
<i>Sienite</i>	. . . . .	Rodd's Bay.
<i>Porphyry</i>	. . . . .	C. Cleveland.
<i>Porphyritic Conglomerate</i>	. . . . .	C. Clinton; Percy I.; Good's I.
<i>Compact Felspar</i>	. . . . .	Percy I.; Repulse Bay; Sunday I.
<i>Green-stone</i>	. . . . .	Vansittart Bay; Bat I.; Careening Bay; Malus I.
<i>Clinkstone</i>	. . . . .	Morgan's I.; Pobassoo's I.
<i>Amygdaloid, with Calcedony</i>	. . . . .	Port Warrender; Half-way Bay; Bat I.; Malus I.
<i>Wacke?</i>	. . . . .	Bat Island.

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<i>Recent calcareous Breccia</i>	. . . . .	Sweer's I., N. coast.—Dirk Hartog's and Rottneet I., &c., W. coast.—King George's Sound, S. coast.
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The only information that has been published respecting the geology of New Holland, besides what is contained in the Voyages of Captain Flinders and Commodore Baudin, is a slight notice by Professor Buckland of some specimens collected during Mr. Oxley's Expedition to the River Macquarie\*, in 1818; and a brief outline of a paper by the Rev. Archdeacon Scott, entitled "A Sketch of the Geology of New South Wales and Van Diemen's Land," which has been read before the Geological Society†. On these autho-

\* Geol. Trans. vol. v. p. 480.

† Ann. of Phil. June, 1824. I am informed that Mr. Von Buch also has published a paper on the rocks of New Holland; but have not been so fortunate as to meet with it.

Since this paper has been at the press, a Report presented to the Academy of Sciences at Paris, on the Voyage of Discovery of M. Duperrey, performed during the years 1822 to 1825, has been published; from whence I have subjoined an extract, in order to

rities, the following may be added to the preceding list of rocks:—

<i>Limestone</i> ,—resembling in the character of its organic remains the mountain limestone of England.	Interior of New Holland, near the east coast; Van Diemen's Land. (Buckland; Prevost MSS; Scott).
<i>The Coal-formation</i> . . . .	East coast of New Holland; Van Diemen's Land. (Buckland; Scott; and others.)
Indications of the new red-Sandstone (Red-Marl), afforded by the occurrence of <i>Salt</i> . . . .	Van Diemen's Land. (Scott.)
<i>Oolite</i> . . . . .	Van Diemen's Land. (Scott.)

II. The specimens of Captain King's and Mr. Brown's collections, without any exception, agree with those of the same

complete the catalogue of the rocks of Australia, according to the present state of our information.

“ Les échantillons recueillis tant dans les contrées voisines du Port Jackson, que dans les Montagnes-Bleues, augmentent beaucoup nos connoissances sur ces parties de la Nouvelle Hollande. Les échantillons, au nombre de soixante-dix, nous offrent, 1°. Les *granites*, les *syénites-quartzifères*, et les *pegmatites* (granites graphiques) qui constituent le second plan des Montagnes-Bleues. 2°. Les *grès ferrugineux*, et renfermant d'abondantes paillettes de *fer oligiste*, qui couvrent non seulement une vaste étendue de pays près des côtes, mais encore le premier plan des Montagnes-Bleues; et 3°. Le *lignite stratiforme* qu'on exploite au Mont-Yorck, à 1000 pieds au-dessus du niveau de la mer, et dont la présence ajoute aux motifs qui portent à penser que les *grès ferrugineux* de ces contrées appartiennent au système des terrains tertiaires.

Vingt-sept échantillons ramassés à la terre de Van Diemen, dans les environs du port Dalrymple, et près du Cap Barren, indiquent, 1°. Des terrains de *pegmatite*, et de *serpentine*. 2°. Des

denominations from other parts of the world; and the resemblance is, in some instances, very remarkable:—The sand-stones of the west and north-west of New Holland are so like those of the west of England, and of Wales, that the specimens from the two countries can scarcely be distinguished from each other; the arenaceous cement in the calcareous breccia of the west coast is precisely the same with that of Sicily; and the jasper, calcedony, and green quartz approaching to heliotrope, from the entrance of Prince Regent's River, resemble those of the Tyrol, both in their characters and association.—The Epidote of Port Warrender and Careening Bay, affords an additional proof of the general distribution of that mineral; which, though perhaps it may not constitute large masses, seems to be of more frequent occurrence as a component of rocks than has hitherto been supposed \*. The mineral itself, both crystallized and compact, the latter in the form of veins traversing sienitic rocks, occurs, in Mr. Greenough's cabinet alone,—from Malvern, North Wales, Ireland, France, and Upper Saxony. Mr. Kœnig has found it extensively in the sienitic tract of Jersey †; where blocks of a pudding-stone, bearing some resemblance to the green breccia of Egypt, were found to be composed of compact epidote, including very large peb-

terrains intermediaires coquilliers, formés du *grauwacke-schistoïde*, et de *Pierre calcaire*. 3°. Des terrains très-récens, composés d'*argile sablonneuse* et *ferrugineuse*, avec *gêodes de fer hydraté*, et du *bois fossile*, à différens états. On distingue en outre des belles *topazes blanches* ou *bleuâtres*, parmi les *galets quartzæux*, qui ont été recueillis au Cap Barren."—*Bulletin des Sciences Naturelles*, Oct. 1825, p. 189.

\* See Cleaveland's Mineralogy, 1816, p. 297-300.

† Plee's Account of Jersey, 4to. Southampton, 1817. p. 231—276.

bles of a porphyritic rock, which itself contains a considerable proportion of this substance.—And Mr. Greenough has recently received, among specimens sent home by Mr. J. Burton, junior, a mass of compact epidote, with quartz and felspar, from Dokhan, in the desert between the Red Sea and the Nile. When New Holland is added to these localities, it will appear that few minerals are more widely diffused.

III. The unpublished sketches, by Captain King and Mr. Roe, of the hills in sight during the progress of the survey of the Coasts of Australia, accord in a very striking manner with the geological character of the shore. Those from the east coast, where the rocks are primitive, representing strongly marked and irregular outlines of lofty mountains, and frequently, in the nearer ground, masses of strata highly inclined. The outlines on the contrary, on the north, north-west, and western shores, are most commonly uniform, rectilinear,—the summits flat, and diversified only by occasional detached and conical peaks, none of which are very lofty.

IV. No information has yet been obtained, from any of the collections, respecting the diluvial deposits of Australia: a class of phenomena which is of the highest interest, in an island of such vast extent, so very remote in situation, and of which the existing animals are so different from those of other parts of the globe. It is remarkable, also, that no lime-stone is among the specimens from the northern and western shores, except that of the recent breccia; and although negative conclusions are hazardous, it would seem probable, from this circumstance, that lime-stone cannot be very abundant or conspicuous at the places visited.—No eruptive mountains, nor any traces of recent volcanic eruption, have yet been observed in any part of Australia.



V. The recent calcareous breccia, of which a detailed description will be found in the subjoined list of specimens, (p. 53-57.), is one of the most remarkable productions of New Holland: It was found, during the expedition of Commodore Baudin, to exist throughout a space of no less than twenty-five degrees of latitude, and an equal extent of longitude, on the southern, west, and north-west coasts\*; and from Mr. Brown's specimens it appears to occur also on the shores of the Gulf of Carpentaria. The full account which M. Péron has given of this formation, sufficiently shows its resemblance to the very recent lime-stone, full of marine shells, which abounds on the shores of the Mediterranean, the West India Islands, and in several other parts of the world: And it is a point of the greatest interest in geology, to determine, whether any distinct line can really be drawn, between those concretions unquestionably of modern formation, which occur immediately upon the shore, and other calcareous accumulations, very nearly resembling them,—if not identical, both in the fossils they contain, and in the characters of the cementing substances,—that are found in several countries, at considerable heights above the sea.

Dr. Buckland has described a breccia of modern formation, which occurs upon the shore at Madagascar, and consists of a firmly-compacted cream-coloured stone, composed of granular fragments of shells, agglutinated by a calcareous cement†. The stone of Guadeloupe, containing the human skeletons, is likewise of the same nature; and its very recent production cannot be doubted, since it contains fragments of stone axes, and of pottery‡.—The cemented

\* Voyage ii. p. 168, 169—216, &c.

† Geol. Trans. vol. v. p. 479.

‡ Linnean Trans. xii. p. 53—57.

shells of Bermuda, described by Captain Vetch \*, which pass gradually into a compact lime-stone, differ only in colour from the Guadeloupe stone; and agree with it, and with the calcareous breccia of Dirk Hartog's Island, in the gradual melting down of the cement into the included portions, which is one of the most remarkable features of that rock †. A calcareous compound, apparently of the same kind, has been recently mentioned, as of daily production in Anastasia Island, on the coast of East Florida ‡; and will probably be found to be of very general occurrence in that quarter of the globe. And Captain Beaufort's account of the process by which the gravelly beach is cemented into stone, at Selinti, and several other places on the coast of Karamania, on the north-east of the Mediterranean §, accords with M. Péron's description of the progress from the loose and shifting sand of the dunes to solid masses of rock ||. In the island of Rhodes, also, there are hills of pudding-stone, of the same character, considerably elevated above the sea. And Captain W. H. Smyth,

\* Geol. Trans. 2d. Series, vol. i. p. 172.

† Koenig. Phil. Trans. 1814. p. 107, &c.

‡ Bulletin des Sciences Nat.;—Mars, 1825.

§ Beaufort's "Description of the South Coast of Asia Minor," &c. Second edition. London, 1818: pp. 180—184, &c. In the neighbourhood of Adalia, the deposition of calcareous matter from the water, is so copious, that an old water-course had actually 'crept upwards to a height of nearly three feet'; and the rapidity of the deposition was such, that some specimens were collected on the grass, where the stony crust was already formed, although the verdure of the leaf was as yet but imperfectly withered (p. 114): a fact, which renders less extraordinary M. Péron's statement, that the excrements of kangaroos had been found concreted by calcareous matter.—Péron, vol. ii. p. 116.

|| Voyage ii. 116.



the author of *Travels in Sicily*, and of the *Survey of the Mediterranean* recently published by the Admiralty, informs me, that he has seen these concretions in Calabria, and on the coasts of the Adriatic;—but still more remarkably in the narrow strip of recent land, (called the *Placca*,) which connects *Leucadia*, one of the *Ionian Islands*, with the continent, and so much resembles a work of art, that it has been considered as a Roman fabric. The stone composing this isthmus is so compact, that the best mill-stones in the *Ionian Islands* are made from it; but it is in fact nothing more than gravel and sand cemented by calcareous matter, the accretion of which is supposed to be rapidly advancing at the present day.

The nearest approach to the concreted sand-rock of *Australia*, that I have seen, is in the specimens presented by *Dr. Daubeny* to the *Bristol Institution*, to accompany his excellent paper on the geology of *Sicily*\*; which prove that the arenaceous breccia of *New Holland* is very like that which occupies a great part of the coast, almost entirely around that island. Some of *Dr. Daubeny's* specimens from *Monte Calogero*, above *Sciacca*, consist of a breccia, containing angular fragments of splintery limestone, united by a cement, composed of minute grains of quartzose-sand disseminated in a calcareous paste, resembling precisely that of the breccia of *Dirk Hartog's Island*: and a compound of this kind, replete with shells, not far, if at all, different from existing species, fills up the hollows in most of the older rocks of *Sicily*; and is described as occurring, in several places, at very considerable heights above the sea. Thus, near *Palermo*, it constitutes hills some hundred feet in height;—near *Girgenti*, all the most elevated spots are

\* *Edinb. Phil. Jour.* 1825. pp. 116, 117, 118, and 254-5.

crowned with a loose stratum of the same kind; and the heights near Castro Giovanni, said to be 2880 feet above the sea, are probably composed of it. But although the concretions of the interior in Sicily much resemble those of the shore, it is still doubtful whether the former be not of more ancient formation; and if they contain nummulites, they would probably be referred to the epoch of the beds within the Paris basin.

The looser breccia of Monte Pelegriuo, in Sicily, is very like the less compacted fragments of shells from Bermuda, described by Captain Vetch, and already referred to\*:—and the rock in both these cases, nearly approaches to some of the coarser oolites of England.

The resemblance pointed out by M. Prevost †, of the specimens of recent breccia from New Holland, in the museum at the Jardin du Roi, to those of St. Hospice near Nice, is confirmed by the detail given by Mr. Allan in his sketch of the geology of that neighbourhood ‡; in which the perfect preservation of the shells, and their near approach to those of the adjoining sea at the present day, are particularly mentioned; and it is inferred that the date of the deposit which affords them, is anterior to that of the conglomerate containing the bones of extinct quadrupeds, likewise found in that country. M. Brongniart also, who examined the place himself, mentions the recent accumulation “which occurs at St. Hospice, about sixty feet above the present level of the sea,” as containing marine shells in a scarcely fossil state, (‘à peine fossiles;’) and he describes

\* These specimens are in the Museum of the Geological Society.

† Prevost MSS. See hereafter, p. 56.

‡ Trans. of the R. Soc. of Edinb. vol. viii. 1818. p. 427, &c.—See also the previous publications of M. Risso; *Journal des Mines*. tom. xxxiv, &c.

the mass in which they occur, as belonging to "a formation still more recent than the upper marine beds of the environs of Paris \*."

The geological period indicated by these facts, being probably more recent than that of the beds containing nummulites, and generally than the Paris and London strata, accords with the date which has hitherto been assigned to the 'crag beds of Suffolk, Essex, and Norfolk †: but later observations render doubtful the opinion generally received respecting the age of these remarkable deposits, and a full and satisfactory account of them is still a desideratum in the geology of England.—When, also, our imperfect acquaintance with the travertino of Italy, and other very modern lime-stones containing fresh-water shells, is considered ‡,—the continual deposition of which, at the present time, cannot be questioned, (though probably the greater part of the masses which consist of them may belong to an æra preceding the actual condition

\* Brongniart, in Cuvier's "Ossements Fossiles," 2d Edit. vol. ii. p. 427.

† Conybeare and Phillips' "Outlines," &c. p. 11.—Geol. Trans. i. p. 327, &c.—Taylor in Geol. Trans. 2d series, Vol. ii. p. 371. Mr. Taylor states the important fact, that the remains of unknown animals are buried together with the shells' in the crag of Suffolk; but does not mention the nature of these remains.—Since these pages have been at the press, Mr. Warburton, by whom the coast of Essex, and Norfolk has been examined with great accuracy, has informed me, that the fossil bones of the crag, are the same with those of the diluvial gravel;—including the remains of the elephant, rhinoceros, stag, &c.

‡ Some valuable observations on the formation of recent lime-stone, in beds of shelly marl at the bottom of lakes in Scotland, have been read before the Geological Society by Mr. Lyell, and will appear in the volume of the Transactions now in the press.—See Annals of Philosophy, 1825. p. 310.

of the earth's surface),—it would seem that the whole subject of these newer calcareous formations requires elucidation: and, if the inferences connected with them do not throw considerable doubt upon some opinions at present generally received, they show, at least, that a great deal more is to be learned respecting the operations and products of the most recent geological epochs, than is commonly supposed.

Since it appears that the accretion of calcareous matter is continually going on at the present time, and has probably taken place at all times,—the stone thus formed, independent of the organized bodies which it envelopes, will afford no criterion of its date,—nor give any very certain clue to the revolutions which have subsequently acted upon it. But as *marine* shells are found in the cemented masses, at heights above the sea, to which no ordinary natural operations could have conveyed them, the elevation of these shells to their actual place, (if not that of the rock in which they are agglutinated,) must be referred to some other agency:—while the perfect preservation of the shells, their great quantity, and the abundance of the same species in the same places, make it more probable that they lay originally in the situations where we now find them, than that they have been transported from any considerable distances, or elevated by any very turbulent operation. Captain de Freycinet, indeed, mentions that patellæ, worn by attrition, and other recent shells, have been found on the west coast of New Holland, on the top of a wall of rocks an hundred feet above the sea,—evidently brought up by the surge during violent storms\*; but such shells are found in

\* Freycinet, p. 187.—The presence of shells in such situations may often be ascribed to the birds, which feed on their inhabitants. At Madeira, where recent shells are found near the coast at a con-



the breccia of Sicily, and in several other places, at heights too great, and their preservation is too perfect, to admit of this mode of conveyance; and to account for their existence in such situations, recourse must be had to more powerful means of transport.

The occurrence of corals, and marine shells of recent appearance, at considerable heights above the sea, on the coasts of New Holland, Timor, and several other islands of the south, was justly considered by M. Péron as demonstrating the former "abode of the sea" above the land; and very naturally suggested an inquiry, as to the nature of the revolutions to which this change of situation is to be ascribed \*. From similar appearances at Pulo Nias, one of the islands off the western coast of Sumatra, Dr. Jack also was led to infer, that the "surface of that island must at one time have been the bed of the ocean;" and after stating, "that by whatever means it obtained its present elevation, the transition must have been effected with little violence or disturbance to the marine productions at the surface †," he concludes, that the phenomena are in favour of an "*heaving up of the land, by a force from beneath.*" The probable nature of this force is indicated most distinctly, if not demonstrated, by the phenomena which attended the memorable earthquake of Chili, in November, 1820 ‡, which was felt

siderable height above the sea, the Gulls have been seen carrying up the living patellæ, just taken from the rocks.

\* Péron, Voyage, &c. vol. ii. pp. 165-183.

† Geol. Trans., Second Series, vol. i. p. 403, 404.

‡ The statements here referred to, are those of Mrs. Graham, in a letter to Mr. Warburton, which has been published in the Geological Transactions, (Second Series, vol. i. p. 412, &c.); and they are confirmed and illustrated by a valuable paper in the Journal of the Royal Institution for April, 1824, (vol. xvii. p. 38; &c.)

throughout a space of fifteen hundred miles from north to south. For it is stated upon the clearest evidence, that after formidable shocks of earthquake, repeated with little interruption during the whole night of the 19th of November, (and the shocks were continued afterwards, at intervals, for several months,) “ *it appeared, on the morning of the 20th, that the whole line of coast, from north to south, to a distance of about one hundred miles, had been raised above its former level.*”—“ The alteration of level at Valparaiso was about three feet; and some rocks were thus newly exposed, on which the fishermen collected the scallop-shell fish, which was not known to exist there before the earthquake. At Quintero the elevation was about four feet.—“ When I went,” the narrator adds, “ to examine the coast, although it was high-water, I found the ancient bed of the sea laid bare, and dry; with beds of oysters, muscles, and other shells adhering to the rocks on which they grew,—the fish being all dead, and exhaling most offensive effluvia.—And I found good reason to believe that the coast had been raised by earthquakes at former periods, in a similar manner; several ancient lines of beach, consisting of *shingle mixed with shells*, extending, in a parallel direction to the shore, to the height of fifty feet above the sea.”—Such an accumulation of geological evidence, from different quarters and distinct classes of phenomena, concurs to demonstrate the existence of most powerful expansive forces within the earth,—and to testify their agency in producing

The writer of this latter article asserts, that “ the whole country, from the foot of the Andes to far out at sea, was raised by the earthquake; the greatest rise being at the distance of about two miles from the shore. The rise upon the coast was from two to four feet :—at the distance of a mile, inland, it must have been from five to six, or seven feet.” pp. 40, 45.

the actual condition of its surface,—that the phenomena just now described are nothing more than what was to be expected from previous induction. These facts, however, not only place beyond dispute the existence of such forces, —but show that, even in detail, their effects accord most satisfactorily with the predictions of theory. It is not, therefore, at all unreasonable to conceive, that, in other situations, phenomena of the same character have been produced by the same cause,—though we may not at present be enabled to trace its connexion with the existing appearances so distinctly; and though the facts, when they occurred, may have been unnoticed,—or may have taken place at periods beyond the reach of historical record, or even beyond the possibility of human testimony.

M. Péron has attributed the great abundance of the modern breccia of New Holland to the large proportion of calcareous matter, principally in the form of comminuted shells, which is diffused through the siliceous sand of the shores in that country \*; and as the temperature, especially of the summer, is very high on that part of the coast where this rock has been principally found, the increased solution of carbonate of lime by the percolating water, may possibly render its formation more abundant there, than in more temperate climates. But the true theory of these concretions, under any modification of temperature, is attended with considerable difficulty:—and it is certain that the process is far from being confined to the warmer latitudes. Dr. Paris has given an account of a modern formation of sand-stone on the northern coast of Cornwall †;

\* Péron, *Voyage*, &c. ii. p. 116.

† *Trans. of the Geol. Soc. of Cornwall*, vol. i. p. 1, &c.

where a large surface is covered with a calcareous sand, that becomes agglutinated into a stone, which he considers as analogous to the rocks of Guadaloupe; and of which the specimens that I have seen, resemble those presented by Captain Beaufort to the Geological Society, from the shore at Rhodes.—Dr. Paris ascribes this concretion, not to the agency of the sea, nor to an excess of carbonic acid, but to the solution of carbonate of lime itself in water, and subsequent percolation through calcareous sand; the great hardness of the stone arising from the very sparing solubility of this carbonate, and the consequently very gradual formation of the deposit.—Dr. Mac Culloch describes calcareous concretions, found in banks of sand in Perthshire, which “present a great variety of stalactitic forms, generally more or less complicated, and often exceedingly intricate and strange\*,” and which appear to be analogous to those of King George’s Sound and Sweer’s Island:—And he mentions, as not unfrequently occurring in sand, in different parts of England, (the sand above the fossile bones of Norfolk is given as an example,) long cylinders or tubes, composed of sand agglutinated by carbonate of lime, or ‘calcareous stalactites entangling sand,’ which, like the concretions of Madeira, and those taken for corals at Bald-Head, “have been ranked improperly, with organic remains.”

The stone which forms the fragments in the breccia of New Holland, is very nearly the same with that of the cement by which they are united;—the difference consisting only in the greater proportion of sand which the fragments contain:—and it would seem, that after the consolidation of

\* “On an arenaceo-calcareous substance,” &c.—Quarterly Journal, (Royal Institution), Oct. 1823, vol. xvi. p. 79-83.



the former, and while the deposition of similar calcareous matter was still in progress, the portions first consolidated must have been shattered by considerable violence. But, where no such fragments exist, the unequal diffusion of components at first uniformly mixed,—and even the formation of nodules differing in proportions from the paste which surrounds them, may perhaps admit of explanation, by some process analogous to what takes place in the preparation of the compound of which the ordinary earthenware is manufactured;—where, though the ingredients are divided by mechanical attrition only, a sort of chemical action produces, under certain circumstances, a new arrangement of the parts\*. And this explanation may, probably, be extended to those nodular concretions, generally considered as contemporaneous with the paste in which they are enveloped, the distinction of which, from conglomerates of mechanical origin, forms, in many cases, a difficulty in geology. What the degree may be, of subdivision required to dispose the particles to act thus upon each other, or of fluidity to admit of their action, remains still to be determined.

\* The clay and pulverized flints are combined for the use of the potter, by being first separately diffused in water to the consistence of thick cream, and when mixed in due proportion are reduced to a proper consistence by evaporation. During this process, if the evaporation be not rapid and immediate, or if the ingredients are left to act on each other, even for twenty-four hours, the flinty particles unite into sandy grains, and the mass becomes unfit for the purposes of the manufacturer.—I am indebted for this interesting fact, which, I believe, is well known in some of the potteries, to my friend Mr. Arthur Aikin. And Mr. Herschel informs me, that a similar change takes place in recently precipitated carbonate of copper; which, if left long moist, concretes into hard gritty grains, of a green colour, much more difficultly soluble in ammonia than the original precipitate.

VI. As the superficial extent of Australia is more than three-fourths of that of Europe, and the interior may be regarded as unknown \*, any theoretic inferences, from the slight geological information hitherto obtained respecting this great island, are very likely to be deceitful; but among the few facts already ascertained respecting the northern portion of it, there are some which appear to afford a glimpse of general structure.

Captain Flinders, in describing the position of the chains of islands on the north-west coast of Carpentaria,—Wes-sell's, the English Company's, and Bromby's Islands,—re-marks, that he had “frequently observed a great similarity both in the ground plans, and the elevations of hills, and of islands, in the vicinity of each other, but did not recollect another instance of such a likeness in the arrangement of clusters of islands†.” The appearances which called for this observation, from a voyager of so much sagacity and experi-

\* The following are the proportions assigned by Captain de Freycinet to the principal divisions of the globe.—*Voyage aux Terres Australes*, p. 107.

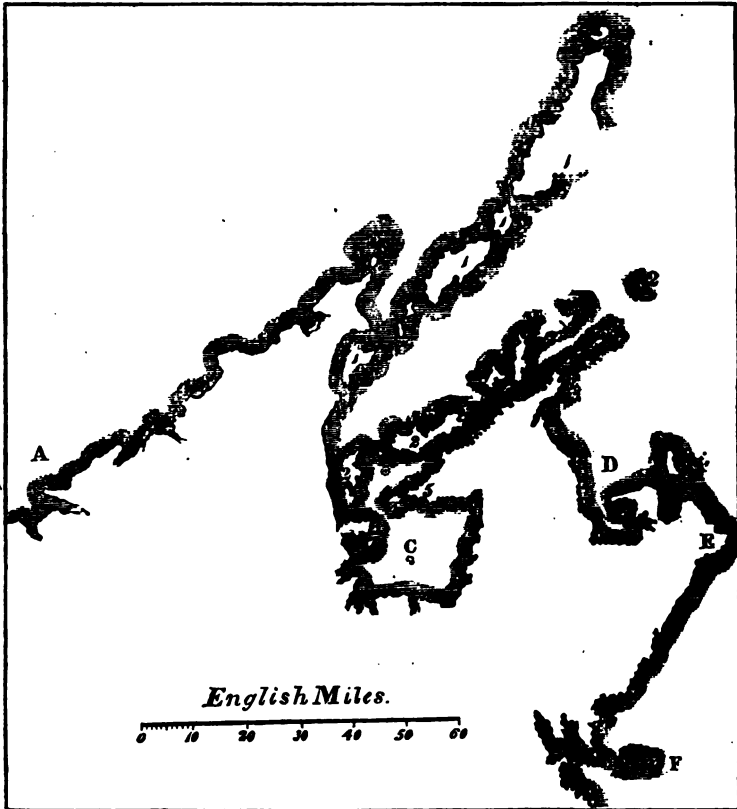
	French leagues square.	Proportions.
Asia . . .	2,200,000	17
America . . .	2,100,000	17
Africa . . .	1,560,000	12
Europe . . .	501,875	4
Australia . . .	334,375	3

The most remote points from the coast of New South Wales, to which the late expeditions have penetrated, (and the interior has never yet been examined in any other quarter,) are not above 500 miles, in a direct line, from the sea; the average width of the island from east to west being more than 2000 miles, and from north to south more than 1000 miles.

† Flinders, v. ii. p. 246; and Charts, Plates 14 and 15.—King's Charts, Plate 4.

ence in physical geography, must probably have been very remarkable; and, combined with information derivable from the charts, and from the specimens for which we are indebted to Captain King and Mr. Brown, they would seem to point out the arrangement of the strata on the northern coasts of New Holland.

Of the three ranges which attracted Captain Flinders's notice, (see the subjoined Map,) the first on the south-east, (3, 4, 5, 6, 7,) is that which includes the Red Cliffs, Mallison's Island, a part of the coast of Arnhem's Land, from Cape Newbald to Cape Wilberforce, and Bromby's Isles; and its length, from the main land (3) on the south-west of Mallison's Island, to Bromby's Isles, (7) is more than fifty miles, in a direction nearly from south-west to north-east. The English Company's Islands, (2, 2, 2, 2,) at a distance of about four miles, are of equal extent; and the general trending of them all, Captain Flinders states (p. 233), is nearly N.E. by E., 'parallel with the line of the main coast, and with Bromby's Islands.'—Wessell's Islands, (1, 1, 1, 1,) the third or most northern chain, at fourteen miles from the second range, stretch out to more than eighty miles from the main land, likewise in the same direction.



- |   |                 |  |
|---|-----------------|--|
| A | Castlereagh Bay | 1, 1 &c.—Wessell's Islands             |
| B | Point Dale      | 2, 2 &c.—The English Company's Islands |
| C | Arnhem Bay      | 3 — Red Cliffs                         |
| D | Melville Bay    | 4 — Mallison's Island                  |
| E | Cape Arnhem     | 5 — Cape Newbald                       |
| F | Caledon Bay     | 6 — Cape Wilberforce                   |
|   |                 | 7 — Bromby's Islands                   |

It is also stated by Captain Flinders, that three of the English Company's Islands which were examined, slope down  
d 2

nearly to the water on their west sides; but on the east, and more especially the south-east, they present steep cliffs; and the same conformation, he adds, seemed to prevail in the other islands \*. If this structure occurred only in one or two instances, it might be considered as accidental; but as it obtains in so many cases, and is in harmony with the direction of the ranges, it is not improbably of still more extensive occurrence, and would intimate a general elevation of the strata towards the south-east.

Now on examining the general map, it will be seen, that the lines of the coast, on the main land west of the Gulf of Carpentaria, between Limmen's Bight and Cape Arnhem,—from the bottom of Castlereagh Bay to Point Dale,—less distinctly from Point Pearce, lat.  $14^{\circ} 23'$ , long.  $129^{\circ} 18'$ , to the western extremity of Cobourg Peninsula,—and from Point Coulomb, lat.  $17^{\circ} 20'$ , long.  $123^{\circ} 11'$ , to Cape Londonderry, have nearly the same direction;—the first line being about one hundred and eighty geographical miles, the second more than three hundred, and the last more than four hundred miles, in length †. And these lines, though broken

\* Flinders, Vol. ii. p. 235.

† It is deserving of notice, that the coast of Timor, the nearest land on the north-west, at the distance of about 300 miles, is also nearly straight, and parallel to the Coast of New Holland in this quarter: part of the mountainous range, of which that island consists, being probably more than 9000 feet high; and its length, from the north-eastern extremity to the S.W. of the adjoining island of Rottee, about 300 miles.—But, unfortunately for the hypothesis, a chain of islands immediately on the north of Timor, is continued nearly in a right line for more than 1200 miles, (from Sermatta Island to the south-eastern extremity of Java), in a direction *from east to west*. This chain, however, contains several volcanoes, including those of Sumbawa, the eruption of which,

by numerous irregularities, especially on the north-west coast, are yet sufficiently distinct to indicate a probable connexion with the geological structure of the country; since the coincidence of similar ranges of coast with the direction of the strata, is a fact of very frequent occurrence in other parts of the globe\*. And it is observable that considerable uniformity exists in the specimens, from the different places in this quarter of New Holland which have been hitherto examined; sandstone, like that of the older formations of Europe, occurring generally on the north and north-west coasts, and appearing to be extensively diffused on the north-west of the Gulf of Carpentaria, where it reposes upon primitive rocks†.

in 1815, was of extraordinary violence. See *R. Inst. Journal*, vol. i. (1816), p. 248, &c.

At Lacrosse Island, in the mouth of Cambridge Gulf, on the north-west coast of New Holland, the beds rise to the N.W.: their direction consequently is from S.W. to N.E.; and the rise towards the high land of Timor. The intervening sea is very shallow.

\* A remarkable case of this kind, which has not, I believe, been noticed, occurs in the Mediterranean; and is conspicuous in the new chart of that sea, by Captain W. H. Smyth. The eastern coast of Corsica and Sardinia, for a space of more than two hundred geographical miles, being nearly rectilinear, in a direction from north to south; and, Captain Smyth has informed me, consisting almost entirely of granite, or, at least, of primitive rocks. The coast of Norway affords another instance of the same description; and the details of the ranges in the interior of England furnish several examples of the same kind, on a smaller scale.

† The coast lines nearly at right angles to those above-mentioned,—from the S.E. of the Gulf of Carpentaria to Linmen's Bight,—from Cape Arnhem to Cape Croker,—and from Cape Domett to Cape Londonderry,—have also a certain degree of linearity; but much less remarkable than those which run from S.W. to N.E.

The horn-like projection of the land, on the east of the Gulf of Carpentaria, is a very prominent feature in the general map of Australia, and may possibly have some connexion with the structure just pointed out. The western shore of this horn, from the bottom of the gulf to Endeavour Straits, being very low; while the land on the east coast rises in proceeding towards the south, and after passing Cape Weymouth, lat.  $12^{\circ} 30'$ , is in general mountainous and abrupt: and Captain King's specimens from the north-east coast, shew that granite is found in so many places along this line, as to make it probable that primitive rocks form the general basis of the country in that quarter; since a lofty chain of mountains is continued on the south of Cape Tribulation, not far from the shore, throughout a space of more than five hundred miles. It would carry this hypothesis too far, to infer that these primitive ranges are connected with the mountains on the west of the English settlements near Port Jackson, &c.; where Mr. Scott has described the coal-measures as occupying the coast, from Port Stevens, about lat.  $33^{\circ}$  to Cape Howe, lat.  $37^{\circ}$ , and as succeeded, on the eastern ascent of the Blue Mountains, by sand-stone, and this again by primitive strata\*:—But it may be noticed, that Wilson's Promontory, the most southern point of New South Wales, and the principal islands in Bass's Straits, contain granite; and that primitive rocks occur extensively in Van Diemen's Land.

The uniformity of the coast lines is remarkable also in some other quarters of Australia; and their direction, as well as that of the principal openings, has a general tendency to a course from the west of south to the east of north. This, for example, is the general range of the south-east coast,

\* *Annals of Philosophy*, June, 1824.

from Cape Howe, about lat.  $37^{\circ}$ , to Cape Byron, lat.  $29^{\circ}$ , or even to Sandy Cape, lat.  $25^{\circ}$ ; and of the western coast, from the south of the islands which enclose Shark's Bay, lat.  $26^{\circ}$ , to North-west Cape, about lat.  $22^{\circ}$ .—From Cape Hamelin, lat.  $34^{\circ} 12'$ , to Cape Naturaliste, lat.  $33^{\circ} 26'$ , the coast runs nearly on the meridian. The two great fissures of the south coast, Spencer's, and St. Vincent's Gulfs, as well as the great northern chasm of the Gulf of Carpentaria, have a corresponding direction; and Captain Flinders (Chart 4,) represents a high ridge of rocky and barren mountains, on the east of Spencer's Gulf, as continued, nearly from north to south, through a space of more than one hundred geographical miles, between latitude  $32^{\circ} 7'$  and  $34^{\circ}$ .—Mount Brown, one of the summits of this ridge, about lat.  $32^{\circ} 30'$ , being visible at the distance of twenty leagues.

The tendency of all this evidence is somewhat in favour of a general parallelism in the range of the strata,—and perhaps of the existence of primary ranges of mountains, on the east of Australia in general,—from the coast about Cape Weymouth to the shore between Spencer's Gulf and Cape Howe\*. But it must not be forgotten, that the distance between these shores is more than a thousand miles in a direct line;—about as far as from the west coast of Ireland to the Adriatic, or

\* The possible correspondence of the great *Australian Bight*, the coast of which in general is of no great elevation, with the deeply-indented Gulf of Carpentaria,—tending, as it were, to a division of this great island into two, accords with this hypothesis of mountain ranges: but the distance between these recesses, over the land at the nearest points, is not less than a thousand English miles.—The granite, on the south coast, at Investigator's Islands, —and westward, at Middle Island, Cape Le Grand, King George's Sound, and Cape Naturaliste, is very wide of the line above-mentioned, and nothing is yet known of its relations.



double the distance between the Baltic and the Mediterranean.—If, however, future researches should confirm the indications above mentioned, a new case will be supplied in support of the principle long since advanced by Mr. Michell \*, which appears (whatever theory be formed to explain it,) to be established by geological observation in so many other parts of the world ;—that the outcrop of the inclined beds, throughout the stratified portion of the globe, is every where parallel to the longer ridges of mountains,—towards which, also, the elevation of the strata is directed. But in the present state of our information respecting Australia, all such general views are so very little more than mere conjecture, that the desire to furnish ground for new inquiry, is, perhaps, the best excuse that can be offered for having proposed them.

\* On the Cause of Earthquakes.—Philosophical Transactions, 1760. vol. li. p. 566—585, 586.

### DETAILED LIST OF SPECIMENS.

The specimens mentioned in the following list have been compared with some of those of England and other countries, principally in the cabinets of the Geological Society, and of Mr. Greenough; and with a collection from part of the confines of the primitive tracts of England and North Wales, formed by Mr. Arthur Aikin, and now in his own possession. Captain King's collection has been presented to the Geological Society; and duplicates of Mr. Brown's specimens are deposited in the British Museum.

RODD'S BAY, on the East Coast, discovered by Captain King, about sixty miles south of Cape Capricorn \*.—*Reddish sand-stone*, of moderately-fine grain, resembling that which in England occurs in the coal formation, and beneath it, (mill-stone grit.) A *sienitic compound*, consisting of a large proportion of reddish felspar, with specks of a green substance, probably mica;—resembling a rock from Shap in Cumberland.

CAPE CLINTON, between Rodd's Bay and the Percy Islands.—*Porphyritic conglomerate*, with a base of decomposed felspar, enclosing grains of quartz and common felspar, and some fragments of what appears to be *compact epidote*;

\* In Captain King's collection are also specimens, found on the beach at *Port Macquarie*, and in the bed of the *Hastings River*, of common serpentine, and of botryoidal magnesite, from veins in serpentine. The magnesite agrees nearly with that of Baudissiero, in Piedmont. (See Cleaveland's Mineralogy, 1st edition, p. 345.)

very nearly resembling specimens from the trap rocks\* of the Wrekin and Breeden Hills, in Shropshire. Reddish and yellowish *sandy clay*, coloured by oxide of iron, and used as pigments by the natives.

PERCY ISLANDS, about one hundred and forty miles north of Cape Capricorn.—*Compact felspar* of a flesh-red hue, enclosing a few small crystals of reddish felspar, and of quartz.—This specimen is marked “general character of the rocks at Percy Island,” and very much resembles the compact felspar of the Pentland Hills near Edinburgh, and of Saxony. Coarse *porphyritic conglomerate*, of a reddish hue. *Serpentine*. A trap-like compound, with somewhat the aspect of serpentine, but yielding with difficulty to the knife.—This specimen has, at first sight, the appearance of a conglomerate, made up of portions of different hues, purplish, brown, and green; but the coloured parts are not otherwise distinguishable in the fracture:—It very strongly resembles a rock which occurs in the trap-formation, near Lyd-Hole, at Pont-y-Pool, in Shropshire. *Slaty clay*, with particles of mica; like that which frequently occurs immediately beneath beds of coal.

\* By the terms *Trap*, and *Trap-formation*, which I am aware are extremely vague, I intend merely to signify a class of rocks, including several members, which differ from each other considerably in mineralogical character, but agree in some of their principal geological relations;—and the origin of which very numerous phenomena concur in referring to some modification of volcanic agency. The term *Green-stone* also, is of very loose application, and includes rocks that exhibit a wide range of characters;—the predominant colour being some shade of green, the structure more or less crystalline, and the chief ingredients supposed to be hornblende and felspar,—but the components, if they could be accurately determined, probably more numerous and varied, than systematic lists imply.

REPULSE ISLAND, in Repulse Bay, about one hundred and twenty miles north-west of the Percy Islands.—Indistinct specimens, apparently consisting of decomposed *compact felspar*. A compound of quartz, mica, and felspar, having the appearance of re-composed granite.

CAPE CLEVELAND, about one hundred and twenty miles north of Repulse Island.—Yellowish-grey *granite*, with brown mica; "from the summit of the hill." Reddish *granite*, of very fine grain; with the aspect of sand-stone. Dark grey *porphyritic hornstone*, approaching to compact felspar, with imbedded crystals of felspar.

CAPE GRAFTON, about one hundred and eighty miles west of north from Cape Cleveland.—Close grained grey and yellowish-grey *granite*, with brown mica. A reddish granitic stone, composed of quartz, felspar, and tourmaline.

ENDEAVOUR RIVER, about one hundred miles west of north from Cape Grafton.—Grey *granite* of several varieties; from a peaked hill under Mount Cook, and its vicinity. Granular *quartz-rock* of several varieties: and indistinct specimens of a rock approaching to *talc-slate*.

LIZARD ISLAND, about fifty miles east of north from Endeavour River.—Grey *granite*; consisting of brown and white mica, quartz, and a large proportion of felspar somewhat decomposed.

CLACK ISLAND, near Cape Flinders, on the north-west of Cape Melville; about ninety miles north-west of Lizard Island.—Smoke-grey micaceous *slaty-clay*, much like certain beds of the old red sand-stone, where it graduates into grey wacke. This specimen was taken from an horizontal bed, about ten feet in thickness, reposing upon a mass of pudding-stone, which included large pebbles of quartz and

jasper; and above it was a mass of sand-stone, more than sixty feet thick.—(Narrative, vol. ii. p. 26.)

**SUNDAY ISLAND**, near Cape Grenville, about one hundred and seventy miles west of north from Cape Melville.—*Compact felspar*, of a flesh-red colour; very nearly resembling that of the Percy Islands, above-mentioned.

**GOOD'S ISLAND**, one of the Prince of Wales's group, about latitude 10°, thirty-four miles north-west of Cape York.—The specimens, in Mr. Brown's collection from this place, consist of coarse-slaty *porphyritic conglomerate*, with a base of greenish-grey compact felspar, containing crystals of reddish felspar and quartz. This rock has some resemblance to that of Clack Island above-mentioned.

**SWEER'S ISLAND**, south of Wellesley's group, at the bottom of the Gulf of Carpentaria.—A *stalactitic concretion* of quartzose sand, and fine gravel, cemented by reddish carbonate of lime; apparently of the same nature with the stem-like concretions of King George's Sound: (See hereafter, p. 56.) In this specimen the tubular cavity of the stalactite is still open.

The shore, in various parts of this island, was found to consist of red ferruginous matter, (*Bog-iron-ore?*) sometimes unmixed, but not unfrequently mingled with a sandy calcareous stone; and in some places rounded portions of the ferruginous matter were enveloped in a calcareous cement.

**BENTINCK ISLAND**, near Sweer's Island.—A granular compound, like sand-stone recomposed from the debris of granite. *Brown hematite*, enclosing quartzose sand.

**PISONIA ISLAND**, on the east of Mornington's Island; is composed of calcareous *breccia* and *pudding-stone*, which

consist of a sandy calcareous cement, including water-worn portions of reddish ferruginous matter, with fragments of shells.

NORTH ISLAND, one of Sir Edward Pellew's group.—Coarse siliceous sand, concreted by ferruginous matter; which, in some places, is in the state of brown hematite. *Calcareous incrustations*, including fragments of madrepores, and of shells, cemented by splintery carbonate of lime.

CAPE-MARIA ISLAND, in Limmen's Bight, was found by Mr. Brown to be composed principally of *sand-stone*. The specimens from this place, however, consist of grey *splintery hornstone*, with traces of a slaty structure; and of yellowish-grey *flint*, approaching to calcedony; with a coarse variety of cacholong, containing small nests of quartz crystals.

GROOTE EYLANDT is composed of *sand-stone*, of which two different varieties occur among the specimens. A quartzose *reddish sand-stone*, of moderately fine grain; and a coarse reddish compound, consisting almost exclusively of worn pebbles of quartz, some of which are more than half an inch in diameter, with a few rounded pebbles of calcedony. The latter rock is nearly identical with that of Simms' Island, near Goulburn's Island on the north coast.

CHASM ISLAND, WINCHELSEA ISLAND, and BURNEY'S ISLAND, are of the same materials as Groote Eylandt: and *sand-stone* was found also on the western shore of BLUE-MUD BAY.

On the shore of the mainland, opposite to Groote Eylandt, a little north of latitude  $14^{\circ}$ , Mr. Brown observed the "common sandy calcareous stone, projecting here and there in ragged fragments."

MORGAN'S ISLAND, in Blue-Mud Bay, north-west of Groote Eylandt, is composed principally of *clink-stone*, sometimes indistinctly columnar. But among the specimens are also a coarse *conglomerate* of a dull purplish colour,—including pebbles of granular quartz and a fragment of a slaty rock like potstone: the hue and aspect of the compound being precisely those of the oldest sand-stones. Reddish *quartzose sand-stone*, of uniform and fine grain. A concretion of rounded quartz pebbles, cemented by ferruginous matter, apparently of recent formation.

ROUND HILL, near Cape Grindall,—a prominence east of north from Blue-Mud Bay, was found by Captain Flinders to consist, at the upper part, of *sand-stone*. The specimens of the rocks in its vicinity are, dark grey *granite*, somewhat approaching to gneiss, with a few specks of garnet; and a calcareous, probably concretionary stone, enclosing the remains of shells, with cavities lined with crystals of calcareous spar.

MOUNT CALEDON, on the mainland, west of Caledon Bay, consists of grey *granite*, with dark brown mica in small quantity; and on the sides and top of the hill 'large loose blocks of that rock were observed, resting upon other blocks.'

A small island, near Cape Arnhem, is also composed of *granite*, in which the felspar has a bluish hue.

Smaller of the MELVILLE ISLANDS, north-east of Melville Bay \*.—A botryoidal mass of ferruginous *oxide of manganese*, approaching to hematite; the fissures in some places occupied by carbonate of lime.

\* The relative position of the islands and bays on this part of the coast, is represented in the enlarged Map, p. 35.

MELVILLE BAY.—*Granite*, composed of grey and somewhat bluish felspar, dark brown mica, and a little quartz; containing minute disseminated specks of *molybdena*, and indistinct crystals of pale red garnet.

RED CLIFFS, south-west of Arnhem Bay;—on the line of the first chain of islands mentioned by Captain Flinders. (See the Map, p. 35, fig. 3.)—Friable *conglomerate*, of a full brick-red colour, consisting of minute grains of quartz, with a large proportion of ochreous matter.

MALLISON'S ISLAND. (Map, p. 35, fig. 4.)—The cliffs of this island are composed of a fissile primitive rock; on which sand-stone reposes in regular beds. The specimen of the former resembles *gneiss*, or *mica slate*, near the contact with granite: the *sand-stone* is thick-slaty, quartzose, of a reddish hue, with mica disseminated on the surfaces of the joints; and one face of the specimen is incrustated with quartz crystals, thinly coated with botryoidal hematite. Light grey *quartzose sand-stone* of a fine grain, with a thin coating of brown hematite, was also found in this island:—And a *breccia*, consisting of angular fragments of sandstone, cemented by thin, vein-like, coatings of dark brown hematite, was found there, in loose blocks at the bottom of perpendicular cliffs.—The specimen of this breccia is attached to a plate of granular quartz, and may possibly have been part of a vein.

The shore of INGLIS'S ISLAND, the largest of the ENGLISH COMPANY'S RANGE, (2. 2. 2. in the Map, p. 35,) is formed of flat beds, of a slaty argillaceous rock, which breaks into rhomboidal fragments; but the specimen is indistinct. Ferruginous masses, probably consisting of *brown hematite*, come also from this island.



ASTELL'S ISLAND, north-east of Inglis's Isle. Very fine-grained greyish-white *quartzose sand-stone*;—identical with that of Mallison's Island, and very closely resembling some of the specimens from Prince Regent's and Hunter's Rivers.

Among the remaining islands of this range,—BOSANQUET'S, COTTON'S, and POBASSOO'S Isles, were found by Mr. Brown to consist, in a great measure, of *sand-stone*, of the same character with the specimens above-mentioned.

POBASSOO'S ISLAND, a small islet south-east of Astell's Isle.—Fine-grained, somewhat reddish, *sand-stone*. Another specimen of sand-stone is friable, of a light flesh-red colour, and apparently composed of the debris of granite. A crystalline rock, consisting of greenish-grey hornblende, with a very small proportion of felspar (*Hornblende rock?*).—Fragment, apparently from a columnar mass, of a stone intermediate between clink-stone and compact felspar.

Such of the English Company's Islands as were examined by Captain Flinders, are stated by him to consist, in the upper part, of a grit, or *sand-stone*, of a close texture; the lower part being argillaceous, and stratified, and 'separating into pieces of a reddish colour, resembling flat tiles.' The strata-dip to the west, at an angle of about 15°.

South-west bay of GOULBURN'S SOUTH ISLAND, two hundred and fifty miles west of the Gulf of Carpentaria. (Narrative, i. p. 64.)—Coarse-grained reddish quartzose *conglomerate* and *sand-stone*; resembling the older sand-stones of England and Wales, and especially the "mill-stone grit" beneath the coal formation. Fine greyish-white *pipe-clay*; of which about thirty feet in thickness were visible, apparently above the sand-stone last mentioned. Coarse-grained, *ferruginous sand-stone*, containing fragments of

quartz, from above the pipe-clay.—The appearance of the cliff, from which these specimens were taken, is represented in the view of the bay on the south of Goulburn Island, (See page 6); and a distant head in the view consists of the same materials.

SIMMS ISLAND, on the west of Goulburn's south Island, (Narrative, i. p. 70)—is composed of a reddish *conglomerate*, nearly identical with some of the specimens above-mentioned.

The western side of LETHBRIDGE BAY, on the north of MELVILLE ISLAND, consists of a range of cliffs like those at Goulburn's Island; the upper part being red, the lower white and composed of *pipe-clay*. The western extremity of BATHURST ISLAND, between CAPE HELVETIUS and CAPE FOURCROY, is also formed of cliffs of a very dark red colour.

LACROSSE ISLAND, at the mouth of CAMBRIDGE GULF; about one hundred miles from Port Keats.—Reddish, very *quartzose sand-stone*; from a stratum which dips to the south-east, at an angle of about ten or fifteen degrees. Micaceous and *argillaceous* fissile *sand-stone*, of purplish and greenish hues, in patches, or occasionally intermixed;—precisely resembling the rock of Brecon, in South Wales, and, generally, the 'old red sand-stone,' of the vicinity of Bristol and the confines of England and Wales. Fine-grained thin-slaty *sand-stone*, resembling certain beds of the coal formation, or of the millstone grit, is found in large masses, under an "argillaceous cliff," on the north side of Lacrosse Island.

The specimens from the interior of Cambridge Gulf are from ADOLPHUS ISLAND, and consist of reddish and grey *sand-stone*, more or less decomposed.

VANSITTART BAY, about one hundred and forty miles north-west of Cambridge Gulf.—Reddish quartzose *sand-stone*, or *quartz-rock*. Indistinct specimens of *green-stone*, with adhering quartz; apparently a primitive rock.

PORT WARRENDER, at the bottom of Admiralty Gulf, about forty miles south-west of Vansittart Bay, (Narrative, vol. i. p. 322, 323.)—*Epidote* and *quartz*, in small crystals confusedly interlaced; apparently from veins, or nests, but unaccompanied by any portion of the adjacent rock.—The structure in one of these specimens approaches to the amygdaloidal. A compact greenish stone, with disseminated crystalline spots of epidote, and of quartz, and apparently consisting of an intimate mixture of those minerals, is also among the specimens from Port Warrender.

All these specimens are from detached water-worn masses at the foot of Crystal Head, on the south-west of the port. The summit of the head is flat and tabular; and the rocks in the vicinity are described by Captain King as consisting of siliceous sand-stone. *Calcedony*, apparently from amygdaloid of the trap formation, was also found at Port Warrender.

The epidote of this place is in general of a pale-greenish colour, but is mixed with, and sometimes appears to pass into, spots of a rich purplish-brown. The specimens resemble generally the epidote of Dauphiny and Siberia; but Mr. Levy, who has been so good as to examine them, informs me that the crystals exhibit some modifications not described either by Haüy, or by Mr. Haidinger in his paper on this mineral, and which are probably peculiar to this locality.

WATER ISLAND, on the west side of CAPE VOLTAIRE, at the south-west entrance of Port Warrender, is described (vol. i. p. 395) as consisting of quartzose *sand-stone*; as is

also KATER ISLAND, in Montagu Sound. And the same rock appears to occur throughout the islands on this part of the coast.—(Narrative, i. p. 401.)

MONTAGU SOUND, about five-and-twenty miles south-west of ADMIRALTY GULF, (Narrative, i. p. 400.)—Greyish *granular quartz*; like that of the Lickey Hill, in Worcestershire. Fine-grained quartzose *sand-stone*, of a purplish hue, resembling a rock on the banks of the Severn, near Bridgenorth. *Grey and reddish sand-stone*; apparently composed of the debris of granite, and very nearly resembling that of Simms Island above-mentioned.

HUNTER'S RIVER, falling into YORK SOUND, on the north-east side.—Somewhat coarse reddish-white *sand-stone*; like that of the coal formation, and some varieties of millstone grit. Fine-grained, reddish-grey *quartzose sand-stone*, having the appearance of stratification, and resembling the rocks of Cambridge Gulf.

ROE'S RIVER, at the eastern termination of York Sound, (Narrative, i. p. 407, 408, 413,) runs between precipitous banks of *sand-stone*, in nearly horizontal strata, which rise to the height of three hundred feet.

CAREENING BAY, between York Sound and Prince Regent's River, (Narr. i. p. 413; ii. 43, &c. See the annexed plate.)—Crystalline *epidote*, and whitish quartz, apparently from a vein. Purplish-brown *epidote*, with small nests or concretions of green *epidote* and quartz; forming a sort of amygdaloid. *Conglomerate*, containing angular fragments of yellowish-grey quartz-rock, in a base of compact *epidote*. An uniform greenish compound, consisting of *epidote* intimately mixed with *quartz*, also occurs at this place. Flat lamellar *calcedony*. Very fine-grained red-



dish-grey *quartzose sand-stone*, with traces of a slaty structure, resembling that of York Sound, and Cambridge Gulf, was found in the north-east end of this bay; and fine-grained *green-stone*, on the summit of the adjacent hills.

Several of these specimens are almost identical with those of Port Warrender; from which place Careening Bay is distant about sixty miles.

BAT ISLAND, (Narr. i. p. 422,) western entrance of Careening Bay.—Quartz from thin veins, with particles of an adhering rock, probably chlorite-slate. Quartz, containing disseminated *hematitic iron-ore* and *copper pyrites*. Quartz crystals, with calcedony, from nodules in *amygdaloid*. Quartz with *specular iron ore*. *Green-stone*, with calcedony and copper pyrites. A decomposed stone, probably consisting of *wacke*.—The specimens of trap-rocks from this place are from a cavern.

GREVILLE ISLAND, near the entrance of Prince Regent's River.—Reddish, coarsely granular, *siliceous sand-stone*; in horizontal strata, intersected by veins of crystallized quartz\*.

HALF-WAY BAY, within Prince Regent's River on the west of the entrance, near Greville Island.—*Hornblende rock?* nearly agreeing with that of Pobassoo's Island, on the north-west of the Gulf of Carpentaria, (See above, p. 48.) *Calcedony*, apparently from nodules in *amygdaloid*. *Greenish quartz*, approaching to *heliotrope*. Red, somewhat slaty *jasper*, mixed with quartz and calcedony, and containing *specular iron ore*.

The specimens from this place much resemble some of those from Sotto i Sassi, in the Val di Fassa in the Tyrol,

\* Narrative, vol. ii. p. 53.

which I have seen in the collection of Mr. Herschel; and which consist of reddish jasper, with calcedony, and a greenish flinty stone, like heliotrope,—the whole belonging the trap-formation.

POINT CUNNINGHAM, east of south from Cape Lévêque, and about one hundred and fifty miles south-west of Prince Regent's River.—Very compact and fine-grained reddish granular *quartz*, with a glistening lustre, and flat conchoidal fracture. This stone, though so compact in the recent fracture, has distinct traces of stratification on the decomposed surface, which is of a dull reddish hue. Bright red ferruginous *granular quartz*, (Eisen-kiesel?) with a glistening lustre, and a somewhat porous texture. A specimen of 'the soil of the hills' at Cygnet Bay, consists of very fine reddish-yellow quartzose sand. A large rounded pebble, consisting of ferruginous *granular quartz*, of a dark purplish-brown colour, and considerable density, was found here, near a fireplace of the natives, by whom it is used for making their hatchets; with a fragment of a *calcareous incrustation*, like that of the west coast hereafter mentioned.

The next specimens in Captain King's collection,—a space of more than three hundred miles on this coast not having been examined by him—are from MALUS ISLAND, in Dampier's Archipelago [See Narrative, vol. i. p. 56]:—they consist of fine-grained *green-stone*, and what appears to be a basaltic rock, of amygdaloidal structure.

DIRK HARTOG'S ISLAND, west of Shark's Bay.—A compound of rather fine-grained translucent quartzose sand, cemented by carbonate of lime, of various shades of reddish and yellowish grey. This stone has in some places the structure of a breccia; the angles of the imbedded frag-

ments, which are from half an inch to two inches in diameter, being very distinct:—but in other parts, the fracture exhibits the appearance of roundish nodules, composed of concentric shells,—or bags as it were, of calcareous matter, which vary in colour, and are filled with a mixture of the same substance and quartzose sand: and the spaces between these nodules are likewise occupied by a similar compound\*.

\* The following description given by the French naturalists of the rocks at Bernier's Islands, was probably taken from a large suite of specimens; and M. Péron states, (I. p. 204,) that it is strictly applicable to all the adjacent parts of the continent, and of the islands that were examined by the French voyagers:—

“ Le sable du rivage (de l'île Bernier) est quartzueux, mêlé d'une grande proportion de débris calcaires fortement atténués. La substance de l'île même se compose, dans ses couches inférieures, d'un grès calcaire coquillier, tantôt blanchâtre, tantôt rougeâtre, déposé par couches horizontales, dont l'épaisseur varie de 2 à 3 décimètres, (7 à 11 pouces,) et qui toutes étant très uniformes dans leur prolongement, pourroient offrir à la maçonnerie des pierres de construction naturellement taillées.

“ Les coquilles incrustées dans ces massifs des roches sont presque toutes univalves; elles appartiennent plus particulièrement au genre *Natice* de M. de Lamarck, et ont les plus grands rapports avec l'espèce de *Natice* qui se trouve vivante au pied de ces rochers. Elles sont sans doute pétrifiées depuis bien des siècles, car, outre qu'il est très difficile de les retirer intactes du milieu de ces grès, tant leur adhésion avec eux est intime, on les observe encore à plus de 50 mètres (150 pieds) au dessus du niveau actuel de la mer.

“ Quelque régularité que ces bancs puissent affecter dans leur disposition générale, ils ne sont cependant pas tous homogènes dans leur substance; il est sur-tout une variété de ces roches plus remarquable par sa structure. Ce sont des galets calcaires, agrégés dans une terre sablonneuse ocracée, qui leur est tellement adhérente, qu'on ne sauroit détruire cette espèce de gangue sans les briser eux mêmes. Tous ces galets affectent la forme globuleuse,

The cementing lime-stone in the rock of this island, is very like some of the more compact portions of the stone of Guadaloupe, which contains the human skeletons, the hardness and fracture being nearly the same in both. The chief difference of these rocks seems to arise from the nature of the cemented substances;—which, in the Guadaloupe stone, being themselves calcareous, are incorporated, or melted as it were, into the cement, by insensible gradation\*; while the quartzose sand, in that of Dirk Hartog's Island, is strongly contrasted with the calcareous matter that surrounds it†. But, wherever the imbedded fragments in the latter consist of lime-stone, their union with the cement is complete.

• **ROTTNEST ISLAND**, about four hundred and fifty miles south of Dirk Hartog's Island.—Indistinct specimens containing numerous fragments of shells, in a calcareous cement; the substance of these shells has at first sight the

et se composent d'un grand nombre de zones concentriques, qui se développent autour d'un noyau central d'un grès scintillant et brunâtre. Ces diverses couches ont à peine quelques millimètres d'épaisseur, et affectent des nuances agréables, qui varient depuis le rouge-foncé jusqu'au jaune-clair. La disposition générale de cette breche lui donne donc quelques rapports grossiers avec le granit globuleux de l'île de Corse; et, par ses couches rubanées, concentriques, elle a quelque chose de l'aspect des Agathes-Onyx. . . . . Les bancs de grès divers dont je viens de parler, constituent, à bien dire, la masse entière du pays qui nous occupe, &c."—Vol. I. p. 110. See also Freycinet, p. 187.

\* See Mr. Kœnig's Paper. Phil. Trans. vol. civ. (1814) p. 107, &c.

† Captain King informs me that the soundings on this part of the coast, bring up a very fine quartzose-sand, like that cemented in the breccia.



appearance of calcedony, and is harder than ordinary carbonate of lime.

The characters of the shells in Captain King's specimens from this place are indistinct; but the specimens at the Jardin du Roi, which, there is reason to suppose, have come from this part of the coast, contain shells of several species,—belonging among others to the genera, *corbula*, *chama*, *cardium*, *porcellanea*, *turbo*, *cerithium*. M. Prevost, to whom I am indebted for this account, observes, that notwithstanding the recent appearance of the shells, the beds which contain them are stated to occur at a considerable height above the sea: and he remarks, that the aspect of the rock is very like that of the shelly deposit of St. Hospice, near Nice.

KING GEORGE'S SOUND, on the south coast, east of south from Cape Leeuwin.—Beautifully white and fine *quartzose sand*, from the sea-beach. Yellowish grey *granite*, from Bald-head. Two varieties of a *calcareous rock*, of the same nature with that of Dirk Hartog's Island; consisting of particles of translucent quartzose sand, united by a cement of yellowish or cream-coloured carbonate of lime, which has a flat conchoidal and splintery fracture, and is so hard as to yield with difficulty to the knife. In this compound, there are not any distinct angular fragments, as in the stone of Dirk Hartog's Islands; but the calcareous matter is very unequally diffused.

A third form in which this recent calcareous matter appears, is that of irregular, somewhat tortuous, stem-like bodies, with a rugged sandy surface, and from half an inch to an inch in diameter; the cross fracture of which shows that they are composed of sand, cemented by carbonate of lime, either uniformly mixed throughout, or forming a crust around calcareous matter of a spongy texture; in which

latter case they have some resemblance to the trunks or roots of trees.—A mass, which seems to have been of this description, is stated to have come from a height of about two hundred and fifty feet above the sea, at Bald-head, on the South Coast of Australia. These specimens, however, do not really exhibit any traces of organic structure; and so nearly resemble the irregular stalactitical concretions produced by the passage of calcareous or ferruginous solutions through sand\*, that they are probably of the same origin; indeed the central cavity of the stalactite still remains open in some of the specimens of this kind from Sweer's Island in the Gulf of Carpentaria. The specimens from Madeira, presented to the Geological Society by Mr. Bowdich, and described in his notes on that island†, appear upon examination to be of the same character.—But there is no reason to suppose that the trunks of trees, as well as other foreign substances, may not be thus incrustated, since various foreign bodies, even of artificial production, have been so found. Professor Buckland has mentioned a specimen of concreted limestone from St. Helena, which contains the recent shell of a bird's egg‡; and M. Péron states that, in the concretionary limestone rock of the South Coast of New Holland, the trunks of trees occur, with the vegetable structure so distinct as to leave no doubt as to their nature§.

\* Tubular concretions of *ferruginous* matter, irregularly ramifying through sand, like the roots of trees, are described by Captain Lyon as occurring in Africa.—Lyon's Travels, Appendix, p. 65.

† Excursions in Madeira, 1825, p. 139, 140; and Bull. des Sciences Naturelles, vol. iv. p. 322.

‡ Geol. Trans. vol. v. p. 479.

§ Péron, ii. p. 75.

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*INSTRUCTIONS FOR COLLECTING GEOLOGICAL  
SPECIMENS.*

It so often happens that specimens sent from distant places, by persons unpractised in geology, fail to give the instruction which is intended, from the want of attention to a few necessary precautions, that the following directions may perhaps be useful to some of those, into whose hands these pages are likely to fall. It will be sufficient to premise, that two of the principal objects of geological inquiry, are, to determine,—1st, the nature of the *materials* of which the earth is composed; and, 2ndly, the relative *Order* in which these materials are disposed with respect to each other.

1. Specimens of rocks ought not, in general, to be taken from loose pieces, but from large masses in their native place, or which have recently fallen from their natural situation.

2. The specimens should consist of the stone unchanged by exposure to the elements, which sometimes alter the characters to a considerable distance from the surface.—Petrefactions, however, are often best distinguishable in masses somewhat decomposed; and are thus even rendered visible, in many cases, where no trace of any organized body can be discerned in the recent fracture.

3. The specimens ought not to be too small.—A convenient size is about three inches square, and about three-quarters of an inch, or less, in thickness.

4. It seldom happens that large masses, even of the same kind of rock, are uniform throughout any considerable space; so that the general character is collected, by geologists who examine rocks in their native places, from the average of an

extensive surface:—a collection ought therefore to furnish specimens of the most characteristic varieties;—and *the most splendid specimens are, in general, not the most instructive*. Where several specimens are taken from the same place, a series of numbers should be added to the note of their locality.

5. One of the most advantageous situations for obtaining specimens, and examining the relations of rocks, is in the sections afforded by cliffs on the sea-shore; especially after recent falls of large masses. It commonly happens that the beds thus exposed are more or less inclined; and in this case, if any of them be inaccessible at a particular point, the decline of the strata will frequently enable the collector to supply himself with the specimens he wishes for, within a short distance. Thus, in the subjoined sketch, which may be supposed to represent a cliff of considerable height,—the observer being situated at *a*, the beds *b*, *c*, *d*, though inaccessible at that place, may be examined with ease and security, where they successively come down to the shore, at *b'*, *c'*, and *d'*.



6. To examine the *interior* of an unknown country, more skill and practice are required: the rocks being generally concealed by the soil, accumulations of sand, gravel, &c., and by the vegetation of the surface. But the strata are commonly disclosed in the sides of ravines,—in the beds of rivers and mountain-streams; and these, especially where

they cross the direction of the strata, may be made, by careful examination, to afford instructive sections.

7. Among the occasional components of the strata, the remains of organized bodies,—shells, corals, and other zoophytes,—the bones and teeth of animals,—fossile wood, and the impressions of vegetable stems, roots, or leaves, &c., are of the greatest importance; affording generally the most marked characters of the beds in which they occur.—These should, therefore, be particularly sought after, and their relative abundance or rarity in different situations noticed. The petrified bodies should, if possible, be kept united with portions of the rock or matrix in which they are found; and where they are numerous,—in sand, clay, or any moist or friable matrix,—it is in general better to retain a large portion of the whole mass, to be examined afterwards, than to attempt their separation at the time of collecting.

8. The *loose materials* which are found above the solid rocks, in the form of gravel, silt, rolled pebbles, &c., should be carefully distinguished from the *solid strata* upon which they rest. And the more ancient, of these loose materials, found on the sides or summits of hills, &c., should be distinguished from the recent mud, sand, and gravel, brought down by land-floods, or by rivers. The bones and teeth of animals are not unfrequently found in the more ancient gravel; and the collection of these remains from distant quarters of the globe, is an object of the greatest interest to geology.

9. Besides a note of the locality, there ought, if possible, to accompany every specimen, a short notice of its geological circumstances; as—

Whether it be found in large shapeless masses, or in strata?

If in strata,—what are the thickness, inclination to the

horizon, and direction with respect to the compass, of the beds?—[ If these cannot be measured, an *estimate* should always be recorded, while the objects are in view. ]—Are they uniform in dip and direction?—curved, or contorted?—continuous, or interrupted by fissures or veins?

Is the whole cliff, or mass of strata in sight, of uniform composition?—or does it consist of different kinds of stone? If the strata be different,—what is the order in which they are placed above each other successively?

10. A *label*, distinctly written, should accompany every specimen, stating its native place, its relative situation, &c., &c. And these labels should be connected with the specimens immediately, on the spot where they are found\*.—This injunction may appear to be superfluous; but so much valuable information has been lost to geology from the neglect of it, that every observer of experience will acknowledge its necessity; and it is, perhaps, in practice one of the most difficult to adhere to.

11. A *sketch* of a coast or cliff, however slight, frequently conveys more information respecting the disposition and relations of rocks, than a long memorandum. If numbers, denoting the situation of the specimens collected, be marked upon such sketches, much time may be saved at the moment of collecting. But in all such cases, the memorandum should be looked over soon afterwards, and labels distinctly explaining their situation, &c., be attached to the specimens themselves.

12. The specimens should be so packed, that the surfaces

\* It is useful to mark on the labels the day, and even the hour, when each specimen is collected. This, with a corresponding note in the memorandum-book, will be found to assist the memory, and prevent confusion.

may be defended from exposure to air, moisture, and friction: for which purpose, if strong paper cannot be obtained, dry moss, or straw, or leaves, may be employed. Where paper is used for wrapping the specimens, they are best secured by fastening the envelope with sealing-wax.

Lastly, The collector must not be discouraged, nor be prevented from collecting, by finding that the place which he may chance to visit in a remote situation, has not a striking appearance, or the rocks within his view a very interesting character; since it frequently, and even commonly, happens, that facts and specimens, in themselves of very little importance, become valuable by subsequent comparison; so that scarcely any observation, if recorded with accuracy, will be thrown away.

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The *Instruments* required by the geological traveller will vary, according to the acquirements and specific objects of the individual. The most essential are:—

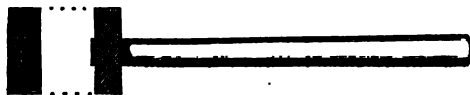
The *Hammer*; which, for general purposes, may be of the form here represented:—



The head should be of steel well tempered, about 4 inches from the face to the edge, and  $1\frac{1}{4}$  inch square in the middle; the face flat, and square, or nearly so; the edge placed in the direction of the handle. The orifice for the insertion of the handle oval, a very little wider on the outer side than within; its diameters, about 1 inch vertically, and  $\frac{7}{10}$  across; the centre some whatmore than  $1\frac{1}{2}$

inch from the face. The handle should be of ash, or other tough wood ; not less than 16 inches long ; fitting tight into the head at its insertion, without a shoulder ; and increasing a little in size towards the end remote from the head, to prevent its slipping.—It should be fixed in the head by means of a thin, barbed iron wedge.

For *trimming* specimens, smaller hammers may be employed:—The form of the head, recommended for this purpose by Dr. Mac Culloch \*, is rectangular. The dimensions of the face may be 1 inch by  $\frac{1}{4}$  ; the height  $2\frac{1}{4}$ .



It will be expedient to have always some hammers, (or at least the heads,) of different sizes, in reserve.

A small *miner's pick* is useful for cutting out, and splitting portions of slaty rocks ; or for obtaining specimens of clays, &c.

A small *stone-cutter's chisel*.—A chisel with a handle, of the form here represented, will often save the hand of an inexperienced collector, and better enable him to direct his blow.



For *Packing the specimens*.—A stock of strong *paper*. *Sealing-wax*. *Writing-paper*, cut into *labels*. Thick *gum-water*, to cement the labels to the specimens.

For the *Conveyance of specimens*.—A large *bag of leather*, with straps for the shoulders. Strong canvas *bags*, of *smaller size*, are very convenient for subdivision and arrangement.—For the protection of crystals, or delicate petrifications, &c., *wool* or

\* "On the forms of Mineralogical Hammers." Quarterly Journal, (R. Inst.) vol. xi, 1821, p. 1, &c.



*otton* are necessary; and small *wooden boxes* (like those used for holding wafers) are sometimes required. For distant carriage, strong *wooden boxes, casks, or baskets*.

The following are either essential, or useful in various degrees, for obtaining and recording observations.

*Pocket Memorandum-Books*, of sufficient size to admit sketches.

*A Pocket Compass.*

*A Measuring-tape*, of fifty feet, or more.

*A Telescope.*

*A Camera Lucida.*

*A Box of Colours.*

The best *Maps* should always be sought for:—And, the true economy to the traveller being that which saves time, it is best to mark, or even to colour the map, in the field. Notes inserted on imperfect maps, or deduced afterwards from memoranda, are less authentic; and the process is frequently neglected.

*Portable-Barometers*, with detached thermometers, are desirable; and the best instruments are ultimately the cheapest. But, unfortunately, barometers of every construction are very easily damaged or deranged.—Minute accuracy, however, in the determination of heights, though very interesting to physical geography, is comparatively of little importance to the geologist.

If the collector be a surveyor, he will know best to what purposes a *Pocket Sextant*, or a small *Theodolite*, is applicable:—the measurement of distances,—of heights,—and of the inclination of strata, &c.

THE END.

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LONDON:

Printed by W. CLOWES, Northumberland-court.





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